Standardized Reclamation Cost Model

User Manual

Public Domain Version

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Version 1.12 Public Domain Version

Disclaimer:
Use of the Standardized Reclamation Cost Estimator (the Model) is conditioned upon your acceptance of the terms and conditions set forth in the Model, as they may be amended from time to time. By opening and using the Model, the use accepts these terms and conditions without limitation.

Prepared with the generous support of:

BARRICK

and

SRK Consulting
Engineers and Scientists

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Table of Contents

Introduction 1-1

Purpose 1-1

Background 1-2

Model Validation 1-2

The Future 1-3

Things to Remember 1-3

Conventions Used In This Manual 1-5

How it Works 2-1

Volume Calculations 2-1

Surface Area Calculations 2-3

Equipment Productivities 2-4

Miscellaneous Productivity Calculations 2-7

Dozing Distance Calculations 2-8

Cycle Times for Material Hauling Fleets 2-9

Fleet Productivities 2-9

Solution Management 2-9

Gathering Your Data 3-1

Cost Data 3-1

Project Data 3-3

Setting Up Cost Data Files 4-1

Source Data 4-2

Basis/Region Table 4-2

Equipment Costs 4-3

Labor Rates 4-4

Reclamation Material Costs 4-5

Miscellaneous Unit Costs 4-5

Indirect Costs 4-6

Entering Data into the Model 5-1

Basic Data Entry 5-1

Basic Model Commands 5-2

Adding Facilities 5-3

Clearing User Data from a Worksheet 5-3
Deleting Facilities 5-4
Entering Data into Worksheets 5-4
Property Information.....5-4
Exploration Data.....5-5
Exploration Drillholes.....5-6
Exploration Trenches 5-6
Exploration Roads and Pads.....5-6
Mine Facilities 5-8
Waste Rock Dumps and Heap Leach Pads 5-8
Tailings Impoundments 5-12
Roads 5-13
Pits 5-14
Underground Openings 5-15
Haul Material 5-15
Foundations and Buildings 5-16
Other Demolition and Equipment Removal 5-18
Diversion Ditches and Sediment Ponds 5-18
Process Ponds 5-19
Landfills 5-20
Yards, Etc.....5-20
Waste Disposal 5-20
Well Abandonment 5-21
Misc. Costs.....5-22
Monitoring.....5-22
Construction Management 5-25
Solution (Water) Management 5-27
Closure Planning 5-28
Other User.....5-28
General and Administration.....5-28
Human Resources.....5-28
User Sheets.....5-29
How do I . . . ?.....6-1
… Import Cost Data in to the Model.....6-1
… Import Data from a Previous Model File.....6-2
… Calculate Closure of Multi-Lift Dumps 6-3
Multi-lift (additive) 6-3
Multi-lift (separate) 6-4

… Create a Cover with More than Two Layers 6-4
… Incorporate Cyanide Code Compliance 6-6
… Calculate Pit Backfilling 6-6
… Add Mobilization and Demobilization Costs 6-6
… Add Site Specific Costs for Materials 6-7
… Get the StdRecCost Menu Back 6-8
… Get Additional Help 6-10
… Report a Model Bug 6-11
… Make a Suggestion for Future Versions 6-12

Tables

Table 1 - Dozer Productivity vs. Grading Distance 2-5

Figures

Figure 1 - Furstrum of a Pyramid 2-1
Figure 2 - Regrading Volume (a) Uphill and (b) Downhill 2-2
Figure 3 - Slope Regrading Cross-Sectional Area Calculation 2-3
Figure 4 - Surface Area Calculations 2-4
Figure 5 - Dozer Productivity vs. Distance 2-6
Figure 6 - Use of Means Crews and Productivities 2-8
Figure 7 - Dozing Distance Calculation 2-8
Figure 8 - Indirect Costs 4-6
Figure 9 - Adding Facilities 5-3
Figure 10 - Deleting Facilities 5-4
Figure 11 - Property Information Worksheet (non-Nevada version shown) 5-5
Figure 12 - Road Recontouring Calculation 5-7
Figure 13 - Exploration Road Inputs 5-7
Figure 14 - Exploration Road Zones 5-8
Figure 15 - Waste Rock Dump or Heap Slope Inputs 5-9
Figure 16 - Regrading Volume Inputs 5-9
Figure 17 - Example Waste Rock Dump 5-11
Figure 18 - User Input for Example Waste Rock Dump 5-11
Figure 19 - Tailings Impoundments 5-12
Figure 20 - Tailings Embankment Parameters 5-13
Figure 21 - Buildings and Foundations 5-17
Figure 22 - Diversion Ditches & Sediment Ponds 5-19
Figure 23 - Process Pond User Input 5-20
Figure 24 - Well Seal Thicknesses 5-22
Figure 25 - Reclamation Maintenance 5-23
Figure 26 - Reclamation Monitoring 5-24
Figure 27 – Rock & Water Monitoring 5-25

Figure 28 – Construction Management 5-26
Figure 29 - Road Maintenance 5-26
Figure 34 - Import Cost Data Menu 6-1
Figure 35 - Import User Data Menu 6-2
Figure 36 - Multi-Lift Slope Inputs (additive) 6-3
Figure 37 - Multi-Lift Slope Inputs - Separate 6-4
Figure 38 - Waste Rock Dumps – Cover and Growth Media Costs 6-5
Figure 39 - Waste Rock Dumps - Scarifying/Revegetation Costs 6-5
Figure 40 - Example of User Cost Data 6-8
Figure 41 - User Tools (Version 1.2 or later) 6-8
Figure 42 - Macro Menu 6-9
Figure 43 - Macro Dialog Box 6-9
Figure 44 - NVBond.org Web Site 6-10
Figure 45 - Frequently Asked Questions (FAQ) 6-10
Figure 46 - Known Issues Page 6-11
Figure 47 - NVBond.org Bug Report 6-11
Figure 48 - NVBond.org Suggestion Page 6-12

Appendices

Appendix A – Technical Reference

Appendix B – Tutorial Exercises

Chapter

1

Introduction

The Model was developed to provide a useful reclamation and closure cost estimating tool that standardizes user input requirements, productivity calculations, volume and area calculations in a consistent format while allowing enough flexibility to incorporate site-specific conditions.

This chapter could be subtitled "Why did we do it?". The answer to that question is fairly simple: we did it to provide a tool to facilitate accuracy, completeness and consistency in the calculation of costs for mine site reclamation. The process to achieve that goal wasn't so simple.

The Standardized Reclamation Cost Estimator (SRCE) model (**the Model**) was originally developed with guidance developed during the implementation of the Nevada Standardized Unit Cost (NSUC) Project, a cooperative effort between the Nevada Division of Environmental Protection, Bureau of Mining Regulation and Reclamation (NDEP), the U.S. Department of Interior, Bureau of Land Management (BLM) and the Nevada Mining Association (NvMA) to facilitate accuracy, completeness and consistency in the calculation of costs for mine sites reclamation.

Purpose

The purpose of the Model is to provide a tool to assist mining professionals improve the consistency and accuracy of reclamation and closure cost estimates. Although the Model was developed to provide standardized approaches to reclamation and closure cost calculations, the need to account for diverse approaches to mine closure, and differences between mining operations and regulatory requirements required that the Model also provide a reasonable amount of flexibility. To that end, the Model requires fairly limited user input to perform the cost calculations yet allows the user to combine or subdivide the input data in a number of different ways to account for site specific conditions and reclamation methods.

Background

In late 2002 a group of mining professionals representing the mining industry, and state and federal regulatory agencies in the State of Nevada (USA) met to discuss the concept of developing a standardized cost estimating approach to improve the consistency of closure cost estimates for surety bonding purposes. This initial meeting led to the formation of the NSUCP, which ultimately provided guidance used in developing the Model.

The Model was originally developed primarily for use in the State of Nevada, and as such the original version tended to focus on the types of facilities and approaches commonly used for mine reclamation and closure in Nevada. The format of the Data Files was also the result of the origins of the Model. Because the initial focus of the Model was to calculate reclamation and closure bond costs, the Data Files needed to be formatted to incorporate certain data and standards required by US and Nevada regulations.

However, even during the initial development, a number of the NSUC Project participants saw the potential to use the Model for other purposes. Among those possible uses were mine closure cost planning, due diligence, feasibility studies, budget tracking and financial reporting requirements. As a result the initial versions and subsequent derivative versions of the Model have been, and are being developed to expand the capabilities to include these other uses. Nonetheless, a Nevada-specific version of the Model does, and may always exist to meet the needs of the industry and regulators in Nevada.

The original version (v. 1.0) of the Model was released for a six-month trial period in March 2006 after about three years of development and beta testing. A second version (v. 1.1) was an update of the original based on feedback from the trial period, and the first metric-capable version was released in mid-2009.

The NSUC Project was implemented largely on a voluntary basis with initial funding provided the NvMA for the development of the original guidelines. The Model continues to be developed and supported primarily on a voluntary basis, and several versions of the Model are publicly available free of charge. For more information on the NSUC Project please see the About SRCE page at the www.nvbond.org website.

Model Validation

Initially, the Model was validated in the State of Nevada (U.S.A.) through an extensive alpha and beta testing process that lasted approximately 18 months. This beta testing process was conducted by representatives from the mining industry, and federal and state regulatory agencies. Beta testers validated the accuracy of the majority of the Model calculations using manual methods, civil CAD software, GIS and other cost

estimating tools. The volumetric calculations were found to be very accurate in comparison to other methods, providing the project data was properly entered. Productivity calculations were largely derived from published sources such as the Caterpillar® Performance Handbook (ed. 35)[1] and were compared against actual field conditions. Although productivity calculations for specific tasks can be highly variable, the beta testing period indicated that the overall time required to perform most tasks was within the range of data from actual projects, or slightly conservative.

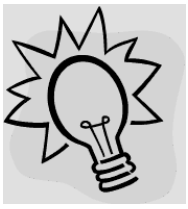
During the six-month trial period following the beta testing process, additional modifications were implemented as well as comparisons with actual field data from ongoing reclamation and closure projects. Version 1.1 (later revised to version 1.1.2), released in October 2006 incorporated a number of changes and enhancements based on input from the trial period, including new productivity formulae for exploration drill road reclamation.

During the period July 2006 through August 2009, a number of enhancements and additions were made to the international (metric) version of the model. These changes were based on feedback provided by a number of users on six continents. Although not every change or new feature requested by the users was incorporated into the current version of the model, many enhancements were made.

The Future

The author of the Model and many of the active supporters of the NSUC Project always envisioned that it would evolve through use, change, improvement and expansion. Several revisions of the Model have already been released since the original trial period ended, including a version that is capable of using either imperial or metric units. Other improvements and additions have already been added to the original version, some of which have been incorporated into the Nevada version of the Model. Others have yet to undergo the testing and approval process required for inclusion in the Nevada version. Many additional capabilities have already been added to the international version of the model, some of which may be added to the Nevada version at some time in the future.

Things to Remember



In order for any model to provide useful results, the user must understand not only the Model but also the system that the Model is intended to simulate. The best results will be obtained from the Model when used by a qualified mine closure professional with an understanding of closure planning, construction techniques used for mine reclamation and closure, and standard cost estimating practices. However, by creating a tool that can be used by less experienced people we recognize that it will be used by people with a broad range of skills and experience. With that in

mind, we offer the following cautions and caveats that one should consider before embarking on the process.

- **The Model results are only an estimate.** It is always tempting to believe the numbers that come out of a computer model without question. However, for a number of reasons, it is important to remember that the Model results are only an estimate. A number of factors that will affect the accuracy of the estimate, but it is nonetheless only an estimate. Issues such as numerical rounding, the reliance of the calculations on other estimates for components such as productivities and volume calculations, and the accuracy of the input data will all affect the level of accuracy. It is important to understand both the limitations of the estimate and the areas of uncertainty in the data used and the calculation methods.

- **Know the intended use of the estimate.** What you plan to do with the estimate will dictate the amount of effort required to gather the information needed to provide the accuracy required from that data.

- **There is more than one way to prepare a cost estimate.** Although the Model provides a fairly simple method for estimating reclamation and closure costs, it is not the only way to do so. There are other tools and approaches to preparing closure cost estimates and some of these may be more suitable for a particular use, or may be appropriate for use in combination with the Model.

- **Results from Model are only as good as the plan and data used as a basis for the cost estimate.** There is nothing in the Model that can make up for an incomplete reclamation and closure plan. It will not add things you left out. It will not correct your input data. That being said, if used properly, it can assist the user in finding gaps in their closure planning process and in certain circumstances may highlight data errors. It can also be used in evaluating the relative costs of different reclamation and closure approaches to assist in the planning process.

- **The Model is only a tool**. It cannot do your work for you and will only provide results based on your input. Don't blame the tool if you don't like the results. A poor workman blames his tools.

- **There is no such thing as perfect software.** Although the process of beta testing, the trial period and subsequent use by mine closure specialists has resulted in rigorous testing of typical uses for the Model,

it also identified a number of needed changes including bug fixes. Testing for any model only includes scenarios contemplated by the testing team, because the Model was developed to be as flexible as possible, there are undoubtedly many possible scenarios that have yet to be tested. As users attempt to use the Model in ways unforeseen by the testing team, new issues are likely to arise. On the other hand, as the Model continues to be used by different people on different mine sites it will improve, provided the users continue to provide feed back. The best way to do that is to submit suggestions and bug reports through the www.nvbond.org web site.

Conventions Used In This Manual

In order to make this manual readable and useful as a functional user guide, standardized text formatting conventions have been used. These formats are intended to highlight different components of the Model and model input requirements.

TEXT CONVENTIONS	
$A_1 \times 1.2 = A_2$	Formula or algorithm
Property Information	Module or Table Name
Regrade Volume	Cell Name
Delete	Button Name

Icons have also been used to highlight important information included in the manual. Notes and tips are shown in grey boxes with the icons along the other edge of the page. Special icons are also used to denote capabilities only available in certain versions of the Model. Generally these differences are cumulative (i.e. what is available in the Nevada version is available in the Metric version, but some options included in the metric version are not available in the Nevada version).

ICON KEY	
	Important Note
	Tip
	Available in Nevada version only
	Available in Metric/Imperial version only
	SRK/Barrick version only

[1] Caterpillar® Performance Handbook, Edition 35, a CAT® publication by Caterpillar Inc., Peoria, Illinois, U.S.A., October 2004

Chapter

2

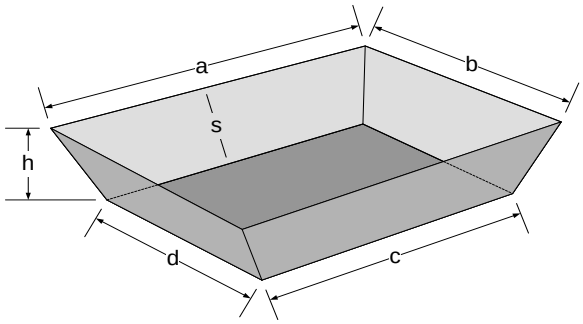
How it Works

The Model was developed to utilize a first-principles approach to reclamation cost estimating, to the best degree possible. A basic understanding of the principles employed to calculate areas, volumes, productivities and time should help the user effectively use the Model.

The methods of calculation used in the Model are based on first-principle approaches for volume and distance calculations, and productivity estimation. In some instances, new approaches and software code were developed to implement and combine these standard methods into a single model that allows both consistency and flexibility.

Volume Calculations

Where possible, the Model uses the simplest methods for volumetric estimation. For example, pond volumes are calculated based on the formula for the furstrum of a regular pyramid to determine pond volumes for backfilling calculations and surface areas for liner installation (see **Figure 1**). Where simple calculations are inadequate to fulfill the goals of simplicity of use and flexibility for site specific conditions, the Model uses combinations of basic formulae or Visual Basic (VBA) code to estimate volumes.



Area and Volume of the Frustrum of a Pyramid

$$\text{Surface Area} = ab + cd + (a+b+c+d) \times \frac{s}{2}$$

$$\text{Volume} = \frac{h\,(ab + cd + \sqrt{abcd}\,)}{3}$$

Figure 1 - Furstrum of a Pyramid

In the case of the calculation of slope regrading volumes creation of a new VBA code was necessitated because the Model needed to calculate volumes for situations where the fill material would be pushed downhill at the toe of the dump (see **Figure 2 (a**)) and situations where the material would be pushed into an opposing hillside (see **Figure 2 (b)**). In both instances, the Model uses a VBA routine to calculate a series of cross-sectional cut and fill areas designated by $\mathbf{A_1}$ and $\mathbf{A_2}$, respectively, using the parameters shown on

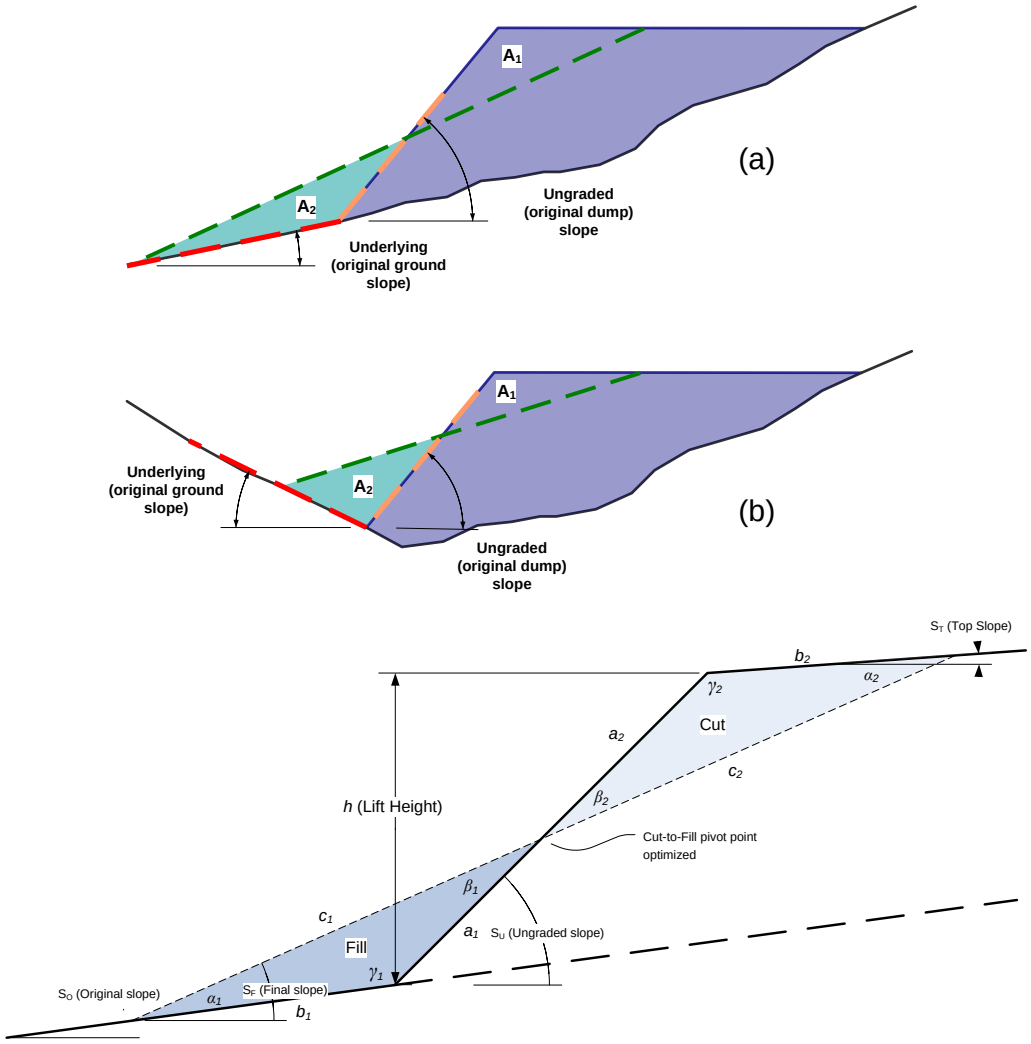


Figure 3 until $A_1 = A_2$. By using this VBA routine the Model determines the exact dimensions necessary for a balanced cut-to-fill.

Figure 2 - Regrading Volume (a) Uphill and (b) Downhill

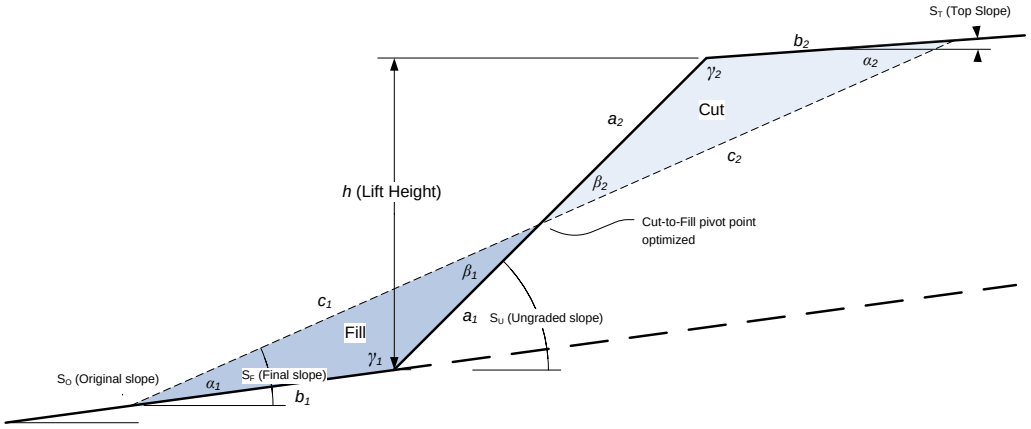


Figure 3 - Slope Regrading Cross-Sectional Area Calculation

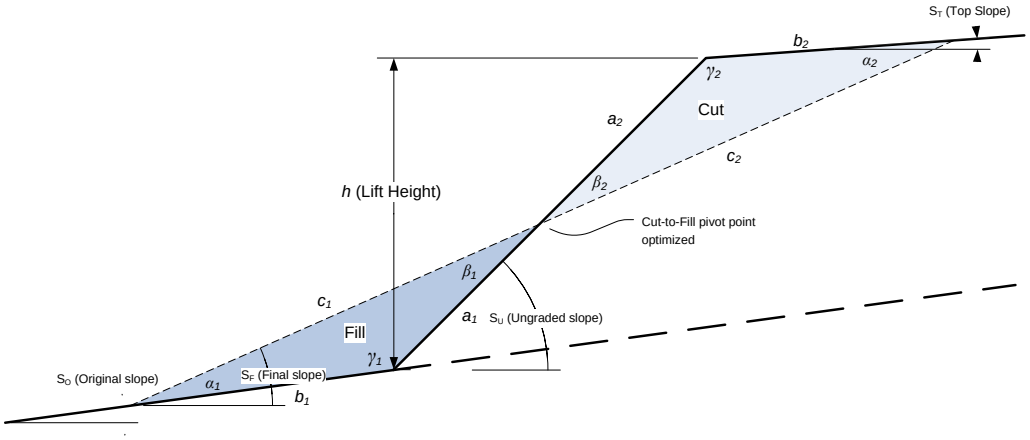
Once the cross-sectional cut and fill areas are determined, the Model estimates the cut-to-fill volume by the formula A_1 *x mid-bench length*. The mid bench length is a user input representing the distance of a line along the contour of the slope approximately ½ the way up the slope. This slope regrading volume estimation method is used in the Waste Rock Dumps, Heap Leach and Tailing Impoundment modules.

The Model also uses a similar method to estimate cut-to-fill volumes for road recontouring, but recognizes that the fill volume requiring placement back in the cut will have expanded during excavation. To account for this the Model applies a 20% swell factor to the cut volume by the formula: $A_1 \times 1.2 = A_2$.

Surface Area Calculations

All calculations in the Model used to determine the quantity of seeded area and the volume of cover material are based on true **surface** areas rather than **footprint** areas. The surface area on non-planar facilities (e.g. waste rock dumps, heap leach pads, etc.) is estimated from the results of the cut-to-fill volume VBA routines as follows:

Final Slope Length = Final Slope of Fill (c_1) + Final Slope of Cut (c_2) (see Figure 3)



Final Disturbance Area = user input (footprint of resloped facility)

Final Slope Surface Area = Mid-Bench Length x Final Slope Length

Final Slope Footprint Area = Horizontal Distance between Final Crest and Final Toe x Mid-Bench Length

Final Flat Area = Total Final Disturbance Area – Final Slope Footprint Area

Final Surface Area = Final Slope Area + Final Flat (Footprint) Area (see **Figure 4**)

Where facilities are assumed to be flat (e.g. yards, tailings impoundment surfaces, landfill surfaces, building foundations, the Model assumes that **surface area = footprint area**.

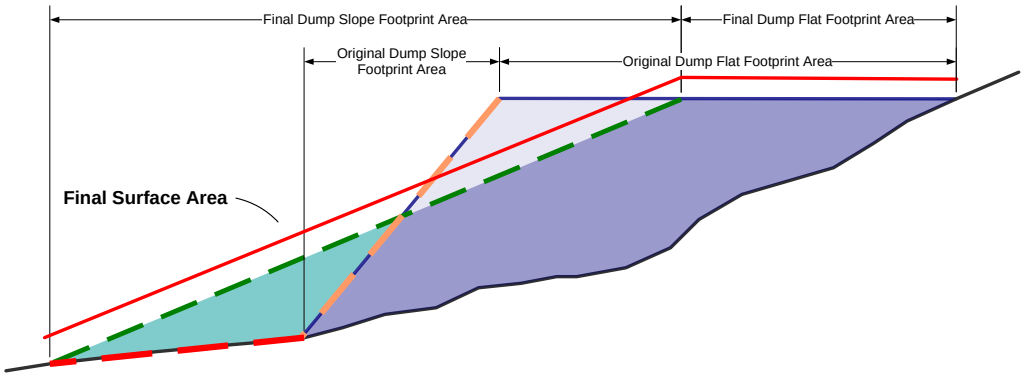

Final Dump Slope Footprint Area
Final Dump Flat Footprint Area
Original Dump Slope Footprint Area
Original Dump Flat Footprint Area
Final Surface Area

Figure 4 - Surface Area Calculations

Equipment Productivities

The Model uses several different sources and methods for calculating equipment productivities. The primary source is the Caterpillar® Performance Handbook[1] (CAT

Handbook). Other sources include the Means Heavy Construction Cost Data 2006[2], equipment and material suppliers, and local contractors. In some instances, such as exploration roads, and drillhole and well abandonment, productivity data was collated from actual work performed in the field and used to adjust the calculated numbers to reflect actual data.

Where the CAT® Handbook was used, several different approaches were used. If productivity curves were include in the Handbook, tables in the Model (see **Table 1**) were created based on those curves and then converted back to curves using the graphing functions in MS Excel. From those graphs, a trendline was fitted to each curve using built-in Excel functions (see **Figure 5**). The formula for each curve is then used in the calculation of equipment productivity for each situation where that equipment is specified by the user. For example, if a D9R dozer is used to push material 280 feet the formula used to calculate the productivity will be:

$$Productivity = 89889 \times 280^{-0.9425}$$

Table 1 - Dozer Productivity vs. Grading Distance

Dozer Productivity vs. Grading Distance						
Average Dozing Distance (feet)	Production (LCY/hr)					
	D11R	D10R	D9R	D8R	D7R	D6R
50	4800	2800	2000	1400	1000	
100	2800	1700	1250	850	700	520
200	1500	950	700	475	375	210
300	1000	625	450	275	250	150
400	750	500	300	175		
500	600	410	250	125		
600	500	350	200	100		
Source: Caterpillar Performance Handbook Edition 35						
dozer productivity = k x Dozing Distance^p (see graph)						
k =	185082	81639	89889	115087	22719	101029
p =	-0.919	-0.8502	-0.9425	-1.0809	-0.7796	-1.1506

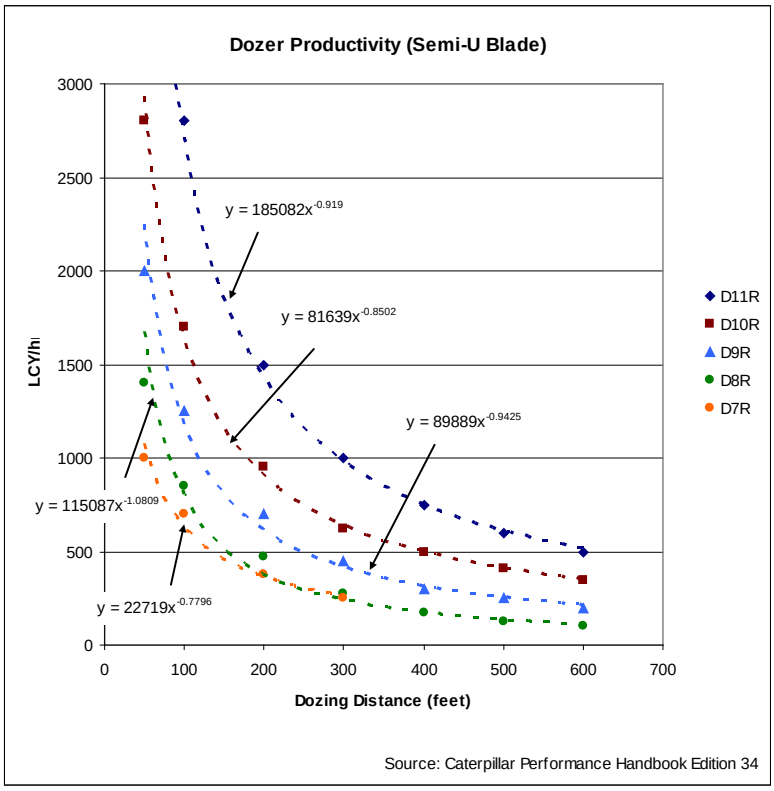


Figure 5 - Dozer Productivity vs. Distance

Other examples of equipment with productivity curves include the uphill travel times for scrapers and trucks. For equipment that utilizes grade retarding curves to determine downhill travel speeds (i.e. scrapers and trucks), speed tables were prepared from the curves. These downhill speed curves were then used in conjunction with the uphill travel time curves to produce cycle times from the user input data.

Productivities for equipment such as loaders and excavators were calculated from cycle time tables and graphs in the CAT® Handbook assuming average bucket capacity and bucket sizes matched to the equipment and task. Average capacity was estimated by the formula:

Average Capacity = Struck Capacity + ½ (Heaped Capacity – Struck Capacity)

As appropriate, correction factors for equipment are added to the productivity calculations for each facility. Some of the correction factors included in the Model for some or all of the equipment include Job Efficiency, Slope Grading, Rolling Resistance, Operator Efficiency, Density Correction, Material Type, Visibility and Slot Dozing. These correction factors are based on information provided in the CAT® Handbook and applied based on industry standards or site-specific conditions. Job Efficiency and

Operator Efficiency correction factors can be adjusted by the user in the International version at the top of the **Productivity** sheet in the Model.

The Model combines the information input by the user for each facility with the productivity formulae, tables and correction factors created from published data and industry data to calculate the individual productivity As an example, if a user adds a 30 meter high dump facility that will require grading from angle-of-repose to a 3H:1V slope, the Model will follow the following steps to estimate the cost to regrade the slope:

1) Calculate volume of cut material to push

2) Calculate the push distance

3) Apply the Dozing Distance vs. Productivity Curve Formulae to estimate uncorrected productivity.

4) Apply correction factors based on user input and standard values to calculation corrected dozer productivity

5) Divide dozing volume by corrected productivity to calculate work hours

6) Multiply equipment and labor rates to work hours to calculate cost.

Miscellaneous Productivity Calculations

Where published equipment data is not available to calculate productivities, other sources including published cost databases, contractor data and field data were used to determine productivity information for other types of equipments and crews.

Bore plugging and well abandonment productivities are based on data from approximately 65 exploration drillholes and 30 monitor and production wells. These data, taken from daily drillers logs were compiled to determine the production rates for casing removal, casing perforation and grouting.

Productivities for demolition and other miscellaneous tasks are estimated from information contained in and used by permission from Means Heavy Construction Cost Data 2006[3] (Means). As an example, wall demolition productivities (and crews) from Means are combined with the equipment and labor cost data imported into the Model to calculate a unit cost for each wall type (see **Figure 6**).

	Means Number	Unit	Crew	Daily Output	Materials	Labor	Equipment	Premium	Total	Notes
Wall Demolition										
Block 4" thick	02220-130-2000	S.F	1 Clab	180		$1.53		20%	$1.84	assumes vertical reinforcing rods included (20% premium)
Block 6" thick	02220-130-2040	S.F	1 Clab	170		$1.62		20%	$1.94	assumes vertical reinforcing rods included (20% premium)
Block 8" thick	02220-130-2080	S.F	1 Clab	150		$1.84		20%	$2.21	assumes vertical reinforcing rods included (20% premium)
Block 12" thick	02220-130-2100	S.F	1 Clab	150		$1.84		20%	$2.21	assumes vertical reinforcing rods included (20% premium)
Conc 6" thick	02220-130-2400	S.F	B-9	160		$6.90	$0.94	10%	$8.62	assumes average reinforcing (10% premium)
Conc 8" thick	02220-130-2420	S.F	B-9	140		$7.89	$1.07	10%	$9.86	assumes average reinforcing (10% premium)
Conc 10" thick	02220-130-2440	S.F	B-9	120		$9.20	$1.25	10%	$11.50	assumes average reinforcing (10% premium)
Conc 12" thick	02220-130-2500	S.F	B-9	100		$11.04	$1.50	10%	$13.79	assumes average reinforcing (10% premium)

EQUIPMENT FLEETS			
ACTIVITY AND FLEET	EQUIPMENT UNIT COST (Hourly)	LABOR UNIT COST (Hourly)	TOTAL COST (Hourly)
B-9 - Concrete Wall Demolition			
General Laborer	$0.00	$35.73	$35.73
General Laborer	$0.00	$35.73	$35.73
General Laborer	$0.00	$35.73	$35.73
General Laborer	$0.00	$35.73	$35.73
Foreman	$13.03	$52.01	$65.04
Air Compressor + tools	$15.46	$0.00	$15.46
Totals	$28.49	$194.93	$223.42

Figure 6 - Use of Means Crews and Productivities

Dozing Distance Calculations

The Model uses a simplified estimating technique to determine the effect of dozing distance on the dozer productivity. On short dumps or short lifts on multi-lift dumps the dozing distance calculation method used is likely to result in a slightly conservative productivity because it assumes that the average distance is assumed to be 2/3 of the calculated final slope length (see **Figure 7**). However, on taller slopes, the dozer is likely to make numerous shorter cuts at an angle sub parallel to the final slope angle. This would result in some double-handling of material, but the productivity of each dozer push would be much higher than if the 2/3 of final slope length were applied. The exact effect of this approximation method will depend on the specific dimensions of the slope to be regraded. In some instances, the Model is likely to overestimate the total time required to complete the work. In others, it may slightly underestimate the work time. However, overall it is likely to provide a reasonable approximation of the time required. Comparisons with field data may result in future modifications to this approach.

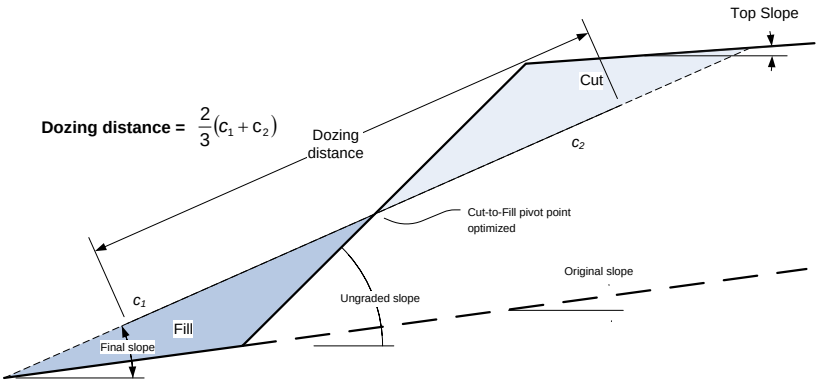


Figure 7 - Dozing Distance Calculation

Cycle Times for Material Hauling Fleets

Cycle times for material hauling fleets are estimated by combining the uphill travel time curves and the downhill travel speed tables with the project data provided by the user. Loaded vehicle weights for use with the travel speed tables are based on standard materials included in the CAT® Handbook. The Rolling Resistance factor used assumes a regularly maintained dirt road will be used. The equipment cycle time is then calculated as follows:

Cycle Time = Maneuver to Load Time + Loading time + Loaded Haul + Dumping Time + Empty Haul Time

The loading time is based on the cycle time for the loading equipment (e.g. front end loader). The loaded and empty haul times are based on either the travel time curves or travel speed tables depending on whether the equipment is performing an uphill or downhill loaded haul.

Fleet Productivities

Fleet productivities are the compilation of the individual equipment productivity of all of the equipment in the fleet. The fleets are assumed to be limited by the cycle time of the loading equipment (i.e. loader limited) and the number of hauling units is determined by the loading cycle. This means that a truck fleet size is determined cycle time of the loader and the loader is assumed to never be idle. For example, if the time required by a truck to make a round trip is slightly more than twice the loader cycle time, then the Model will assume that three trucks are required with two traveling and one being loaded at all times. The overall fleet productivity and work hours are therefore based on the loader productivity. The total cost for hauling is then calculated by multiplying labor and equipment rates by the number pieces of equipment in the fleet including the loader, trucks and spreading dozer.

Dozer loaded scraper fleets are assumed to be dozer limited, and the cycle times and fleet sizes are determined on that basis.

Solution Management

The solution pumping, forced evaporation and decontamination tables included in the **Solution Management** module include cost calculations for pumping water from one location to another using Manning's Equation and other standard hydraulic formulae. This module uses these formulae to estimate the energy (kW) required to pump solution a defined distance with a hydraulic head through a pipe of a known diameter and material. Once the energy required is known, the cost of pumping that water can be calculated by applying the total pumping time and unit cost of the energy.

The forced evaporation option also includes an option for the user to define a required pressure at the end of the pipe.

[1] Ibid.

[2] Means Heavy Construction Cost Data 2006. Reed Construction Data, RSMeans, Kingston, MA., Copyright © 2006

[3] Ibid.

Chapter

3

Gathering Your Data

The Model was designed to allow a variety of input methods while ensuring that the simplest methods would still produce accurate results.

The data required to perform a reclamation cost estimate using the Model is determined by two primary factors; the minimum data required by the Model to calculate costs, and the intended purpose of the cost estimate. The Model requirements dictate the minimum data necessary to produce a usable cost estimate. The intended purpose will define the level of detail of the input data.

The Model requires the user to provide two types of data; **cost data** and **project data**. Cost data include the equipment, labor and material rates required to perform the reclamation and closure activities. Project data are the dimensions, methods, and design criteria used to define the closure plan for the facilities.

Cost Data

The **cost data** required as input to the Model can be obtained from a number of sources and comprise the underlying rate assumptions used in the cost estimation process. The particular cost data required for any estimate will be dependent on the available information and the purpose for which the cost estimate is being prepared. Reclamation cost estimates for the purpose of providing a surety estimate for regulatory purposes typically require the use of government-approved rates. Financial reporting requirements usually dictate the use of third-party contractor rates as a base for equipment, labor and material rates. If the purpose of the cost estimate is for mine planning costs, then actual mine costs, or costs from an analogue mine could provide the most appropriate rate basis.

Important Note

Some regulatory jurisdictions, such as the State of Nevada, require the use of approved cost data. Links to these data files can be found at www.nvbond.org.

Regardless of the purpose of the cost estimate, experience shows that most cost estimates require the use of data from a number of sources, rather than a single one. Some of the most common sources of rate data include:

- **Government Publications** – Many governments publish cost data as part of government contracting procedures. Often these comprise the data required for reclamation and closure cost estimates used for the purpose of determining the amount of regulatory surety required for a project.

  In some jurisdictions, government funded institutes also compile cost data from government contracts and the private sector. These databases can be substantial and have the advantage of tracking costs over time, allowing the analysis of trends. Commonly, the final output from these institutional cost databases is a unit cost for each particular activity. Because the Model does not generally use activity unit costs, much of the data in these databases may not be usable as input to the Model. However, in many instances, these data used to derive these costs including equipment and labor rates, material costs, fleets and productivities are also recorded or can be derived from the published information.

- **Published Cost Databases** – There are a number of commercial cost databases compiled from public and private sources available for purchase. These databases may provide rate data for labor, equipment and materials or unit cost data by activity. If unit costs by activity are provided, the resources (labor, equipment and materials) required for each activity are often provided along with an estimate of the productivity of the assigned resources.

  The resources (crews) and crew productivities from one of these databases (Means Heavy Construction Cost Estimating Guide, ©2006) was used in the Model for some of the miscellaneous unit costs. The Model then combines the crews and productivities with rate data to calculate a Model unit cost for each activity.

- **Third-Party Contractors** – One of the most accurate sources of cost data is a contractor's estimate. Most financial reporting standards require the use of third-party costs. Although contractor's estimates rarely include detailed equipment and labor rates, they may be willing to provide those data upon request. However, when supplying rate data, the contractor may intentionally provide an inflated rate to protect a competitive advantage.

Equipment costs provided by contractors may be inclusive of preventative maintenance, consumables and wear costs. If so, this should be noted and the Data File imported into the Model modified to reflect this (see **Chapter 4 – Setting Up Cost Data Files**). However, the hourly rate for equipment should not include the cost of fuel as this is automatically calculated by the Model based on the fuel cost and published data on fuel consumption for different types of equipment.

When requesting labor rate data from a contractor, the basis for that data should be defined (e.g. government vs. union vs. non-union rates) and upon receiving contractor data, the user should confirm whether the labor rates provided include all indirect costs including fringe benefits, tax withholding, retirement funding, insurance and contractor's profit. If the indirect costs are not available from the contractor, they may be available through government published data.

- **Suppliers** – Material suppliers and vendors are generally the best source of data on reclamation and closure materials. For materials with highly variable rates such as fuel, electricity and seeds, use of data averaged over a period of time such as a year or two may provide a more defensible rate. For costs with demonstrated trends, the addition of an inflation/deflation factor may be appropriate if the term of the cost estimate is long enough to be affected by those trends.

- **Mine Data** – For cost estimates intended for planning and budgeting purposes, the best source of data is generally the mine for which the cost estimate is being calculated, or a similar mine in the general region. Where these data are available, care must be taken to ensure that the reported data includes all indirect costs applicable to the intended purpose of the cost estimate.

Important Note

The data loaded into the Model **must not** include fuel cost. This is calculated in the Model from published fuel consumption data and the fuel cost in the Cost Data File imported into the Model.

Project Data

The Model was designed to allow a broad range of methods for gathering the **project data** required to estimate a reclamation and closure cost. However, the accuracy of the maps and project data available will have a direct impact on the accuracy of any cost estimate prepared using the Model. At a minimum, accurate topographic maps

showing all project facilities at the time of closure and after reclamation is complete are critical to provide user input data required by Model.

- **Maps** - At the most basic level, most of the required project data can be gathered using a topographic map and an engineer's scale. Facility heights can be obtained from the contour elevations. Most distances and areas can be measured approximately with an engineer's scale, and slopes can be calculated from scale measurements and contour elevations printed on the map. A planimeter can be use to improve the accuracy of the distance and area measurements.

- **Electronic CAD Drawings** – Obtaining measurements from drawings created in a CAD package such as AutoCAD is a very effective method of collecting project data required for the different modules of the Model. Two dimensional measurements such as lengths and areas of project facilities can be obtained directly from CAD drawings. Three dimensional parameters such as heights, slopes and volumes can often be directly obtained from CAD drawings or, if necessary, calculated from two dimensional measurements.

- **Mine Planning Software** – Like CAD, mine planning software can provide all of the physical dimensions needed by the Model to calculate the cost estimate. These software packages can also estimate volumes, and often can calculate cycle times, volumes and reshaped slope dimensions, which can be used to check the Model calculations. When using the Model to schedule costs, a mine planning package can also provide useful information on how it will take a given fleet to perform an activity and also assist in the sequencing of the reclamation and closure activities.

- **GIS –** Geographical Information Systems software combine the use of vector and image data into a geographical database. GIS can combine the functionality of data collection from maps, digital design drawings and survey data. Two dimensional measurements such as lengths and areas can be obtained directly from the tables. Three dimensional data can also be incorporated into the attribute tables using built-in formula calculations. Utilizing aerial photography and survey data travel distances and slopes can also be calculated. GIS also provides the ability to document measurements made into tables as a visual auditing trail.

- **Air Photos –** Current aerial photos over a site can provide the basis of the physical dimensions needed by the Model to calculate the cost estimate. Aerial Photos once registered in geographical space allow you

to visually see the footprint of features and can be combined into a GIS database, Vector tables can be created from visually tracing features and then geometrical information can be obtained directly from the GIS.

- **Internet Tools** - other tools such as Google Earth are available via the internet. Google Earth provides aerial photography on a geographical platform where you can draw, measure and obtain physical dimensions for the Model using the tools provided. This method can be extremely helpful in areas where site data is not available and there is current public access to aerial photography at a usable resolution.

Chapter

4

Setting Up Cost Data Files

The cost data used by the Model must first be loaded into a specially formatted cost data file.

There are two types of data files that can be used to load cost data into the Model; Standardized Data Files and User Data Files. Standardized Data Files contain data that can only be modified with a password. The data in User Data Files can be changed by anyone.

- **Standardized Data Files** may be used by regulatory jurisdictions or corporate accounting departments to ensure that the Model uses a particular set of data dictated by regulatory or corporate standards.

- **User Data Files** allow the user to input their own data.

Important Note

Some regulatory jurisdictions, such as the State of Nevada (USA), require the use of approved (standardized) cost data when the Model is used to calculate bond cost estimates required by regulations. Links to these data files can be found at www.nvbond.org.

This user can input up to 15 different bases of cost in a single file, which in turn allows the user to import a single data file into the Model, but switch between bases/regions.

For example, if a single data file is constructed to contain all of the data for different regions of a country or state, then the user would only need a single User Data File to load cost data for any operation within that country or state. Switching between regions within the country or state would only require the user to select a different region on the **Property Information** worksheet in the Model.

Source Data

The Source Data worksheet is intended to capture basic information about the source of the data used to create the file. Some of these cells are automatically filled in by Excel. Others require user input.

Format Version: This is an **automatic** field that is used by the Model to determine if a Data File is in the proper format for the Model version. Because of changes in the Model, different versions of the Model may require different versions of the Data File to load properly. The Data File version is checked by the Model during the Import Data process.

File Name: This is an **automatic** field that contains the name of the file. It will change if you use the Save As command to change the name. The next time you open the file, the saved name will appear in this field.

Date: This is a **user input** field that documents the date for which the cost data was valid. This is a user input field because the valid date of the data may not be the same as the date that the file was saved.

Cost Type: This is an **automatic** field that tells the Model if the data imported is standardized or user data. This information is set by Excel and cannot be changed.

Author/Source: This is a **user input** field that is used to document the source of the data contained in the file.

Units of Measure: This is a **user drop-down** field that selects whether the data contained in the file is in metric (meters, hectares, etc.) or Imperial (feet, acres cubic yards, etc.) units. It is critical that only one type of measurement be used in the Data File and that the units of measure used in the Data File match the units of measure that will be used in the Model.

No. of Bases/Regions: This is an **automatic** field that determines how many different cost bases are contained in this Data File. Excel determines how many different Basis/Region Names the user enters in the Basis/Region section at the bottom of this worksheet.

Basis/Region Table

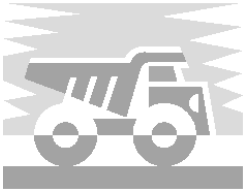
This table contains three columns and fifteen rows used to define different cost bases for the data contained in this file. The data in this table provides the descriptions for one to fifteen different cost bases or regions contained in the Data File.

Basis/Region: This is an **automatic** field that simply labels each basis or region used in the Data File

Basis/Region Name: This is a **user input** field containing the user's description of each cost basis or region. This field might contain a description of the costs such as "Third-party contractor" or "Mine Costs", or it could contain a description of the geographical area for which the data is valid such as "Northern Nevada" or "Western Australia".

Basis/Region Description: This is a **user input** field containing a longer description of the cost basis or region. Because this field allows for word wrapping, there is no programming restriction on how long a description can be input in this field.

Equipment Costs



The **Equipment Costs** worksheet contains the different cost components required by the Model to calculate an hourly equipment rate for each type of equipment used in the Model. There are fifteen columns for each type of data required corresponding to the different cost bases or regions the user defined in the **Source Data** worksheet. Each section contains rows to document the source of the data and or additional user comments.

There are five sections to the **Equipment Costs** worksheet requiring user input. These are:

NOTE:
The **Equipment Costs** worksheet may contain equipment that is not currently used in the Model. Check the **Fleets** worksheet in the Model to determine what equipment is currently being used. The user only needs to input cost data in the **Equipment Costs** worksheet for those pieces of equipment currently used in the Model.

Monthly Rental Basis: This is a **user input** field that defines the number of hours used to calculate the cost. Correct data in this field is critical as it will be used by the Model to determine the hourly costs by dividing the *Monthly Equipment Rental Rate* (cost) by the *Monthly Rental Basis* (hours) to determine the hourly rental cost.

Monthly Equipment Rate Table: This table contains the monthly rental cost for different equipment and different cost bases or regions. These costs could be rental rates, mine ownership costs or any other basis, but typically exclude the equipment costs documented in the other tables in this worksheet.

Preventative Maintenance Cost: This table contains hourly costs for mechanic labor and consumables (excluding fuel, G.E.T. and Tires) used in preventative maintenance of the equipment.

Important Note

The data loaded into the Model **must not** include fuel cost. This is calculated in the Model from published fuel consumption data and the fuel cost in the Cost Data File imported into the Model.

G.E.T. Consumption: This table contains the hourly cost for wear of Ground Engaging Tools for applicable equipment. G.E.T. costs might include the wear costs associated with bulldozer blades, ripper shanks and hydraulic hammers.

Tire Cost Table: This table contains the total cost per tire for equipment with tires. For backhoes or other equipment that use different size tires on the front and back axles calculate the average cost per tire (i.e. (cost of front tire + cost of back tire) ÷ 2).

Labor Rates

The **Labor Rates** worksheet contains hourly rates for the different types of labor used in the Model. These labor costs are categorized by job task, such as Equipment Operators, Truck Drivers, Laborers and Project Management and Technical Labor.

There are columns in the **Labor Rates** worksheet for each labor type corresponding to the different cost bases or regions the user defined in the **Source Data** worksheet. Each basis contains two columns. The first column is used for descriptions, where applicable, and the second column contains the rate.

Equipment Operator and Truck Driver rates are categorized by the type of equipment. Although the same rate may apply to all equipment models in an equipment category (e.g. bulldozers), the data file allows for different rates to be entered for each model. Also, the first column for each basis can be used to define a category or group of labor.

Laborers and **Project Management and Technical Labor** rates are based on the specific job duties of the individual. Laborers are assumed to be hourly employees with fringe benefit and zone adjustments similar to those for equipment operators and truck drivers. Project management and technical labor employees are assumed to be professional employees and their labor rates should include all fringe benefits and zone adjustments as part of the hourly rate.

Each section also contains rows to document **Fringe Benefit** rates, zone adjustments and the source of the data and or additional user comments. Fringe Benefits include any additional employment costs such as medical and retirement plans and are input as an hourly cost.

Zone and Area Adjustments allow the user to define additional costs associated with different areas or zones. For example, if there is an additional premium added to labor rates scaled by distance from a particular location (e.g. a major city), up to seven different hourly zone adjustments can be added. The zone and area adjustments can also be used to account for lodging and meals on projects where laborers will be housed in a camp. Additional adjustments to labor rates can be entered as a cost per hour or a percent of the hourly base rate in the **Labor Rates** worksheet in the Model.

Each section also includes some rows where notes on data sources, zone adjustments or other notes can be entered. In order to ensure the Model results can be audited, the user should take the time to input the source of their labor cost data and any adjustments made thereto.

Indirect Costs such as Social Security, Workman's Compensation, Unemployment Costs or other costs added to the hourly rates in the form of a percentage can be added at the bottom of this worksheet. In the U.S. and other jurisdictions some or all of these indirect costs are mandated by law or regulation. In other jurisdictions, these costs may be defined by corporate policy or labor contracts. Three additional rows are available for other labor rate-specific indirect costs.

Reclamation Material Costs

The **Reclamation Material Costs** worksheet contains unit costs for various materials required for reclamation and closure. There are four major categories in this worksheet including Revegetation Materials, Well Abandonment Materials, Monitoring Costs and Fuel, Etc. The units for each depend on the specific material and the *Units of Measure* selected on the **Source Data** worksheet.

There are fifteen columns included for each type of data required corresponding to the different cost bases or regions the user defined in the **Source Data** worksheet. Each section contains rows to document the source of the data and or additional user comments.

NOTE:
The user can also add additional materials directly into some user input cells in the Materials worksheet in the Model.

This worksheet contains some standard material types as well as providing additional rows in most of the sections for the user to add additional material types. The units are generally automatic fields because the Model requires these data to be input in specific units, although some rows allow the user to input units for these materials. Generally data with user defined units would only be used for calculations done in the **User Sheets** in the Model.

There are rows for notes and data sources in each section of this worksheet.

Miscellaneous Unit Costs

This worksheet contains a number of miscellaneous unit costs that are used in the Model. It also contains some unit costs that are not used by the Model, but could be useful as inputs performed by the user in the **User Sheets** in the Model.

Many of these miscellaneous unit costs are used in the Model in conjunction with crews and productivities defined in Means Heavy Construction Cost Estimating Guide© to estimate costs for non-earthwork activities.

There are columns in the **Miscellaneous Unit Cost** worksheet for each unit cost corresponding to the different cost bases or regions the user defined in the **Source Data** worksheet. Each basis contains two columns. The contents of the two different columns for each basis vary by the type of unit cost being entered. In other cases only one of the cells may be a user input cell.

For some rows, the columns may be user input cells for labor, equipment or material rates. In other sections, the columns may be user input cells for premiums expressed as a percent, daily productivity in number of units completed during an 8-hour shift, or a total cost per unit.

Indirect Costs

This worksheet contains a table to allow the user to input various indirect costs used in the **Cost Summary** table in the Model to apply indirect costs either as a percentage of direct costs, or as a variable rate based on the magnitude of the direct costs.

The format for this table corresponds directly to the U.S. Department of Interior, Bureau of Land Management (BLM) requirements for direct costs. However, the table could be edited to some degree for other uses.

90	**Indirect Costs**				Include?	**Total**
91	1. Engineering, Design and Construction (ED&C) Plan (7)				☑	$100,610
92	2. Contingency (8)				☑	$134,146
93	3. Insurance (9)	$5,948			☑	$5,948
94	4. Bond (10)				☑	$50,305
95	5. Contractor Profit (11)				☑	$167,683
96	6. Contract Administration (12)				☑	$134,146
97	7. BLM Indirect Cost (13)				☑	$28,171
98	**Subtotal Add-On Costs**					**$621,008**
99						
100	**Grand Total**					**$2,297,833**
101						
102	**Administrative Cost Rates (%)**					
103		**Cost Ranges for Indirect Cost Percentages**				
104		<=	<=	<=	>	
105	1. Engineering, Design and Construction (ED&C) Plan (7)	$1,000,000	$25,000,000		$25,000,000	Notice Level
106	Variable Rate	8%	6%		4%	0%
107		<=	<=	<=	>	
108	2. Contingency (8)	$500,000	$5,000,000	$50,000,000	$50,000,000	Notice Level
109	Variable Rate	10%	8%	6%	4%	0%
110	3. Insurance (9)	1.5%	of labor costs			
111	4. Bond (10)	3.0%	of the O&M costs if O&M costs are >$100,000			
112	5. Contractor Profit (11)	10%	of the O&M costs			
113		<=	<=	<=	>	
114	6. Contract Administration (12)	$1,000,000	$25,000,000		$25,000,000	
115	Variable Rate	10%	8%		6%	
116	7. BLM Indirect Cost (13)	21%	of Contract Administration			

Figure 8 - Indirect Costs

Chapter

5

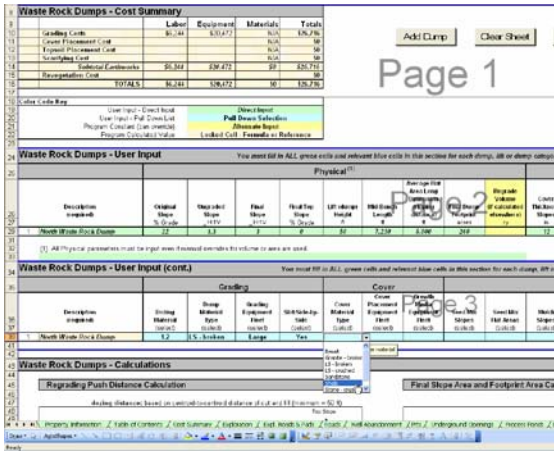
Entering Data into the Model

Once the data has been collected, the process of entering data into the Model is fairly straightforward.

Because the Model was designed to be simple to use, the process of entering the basic data required to create a cost estimate for simple projects, little additional effort is necessary to produce a viable cost estimate with the Model. However, many projects have unique requirements that necessitate the need for special techniques using the Model or external calculation using other tools or methods. Most of the modules in the Model allow the user to implement different approaches to calculating the reclamation costs. The most appropriate method utilized in each instance will depend on the configuration of the facility and the requirements for reclamation and closure.

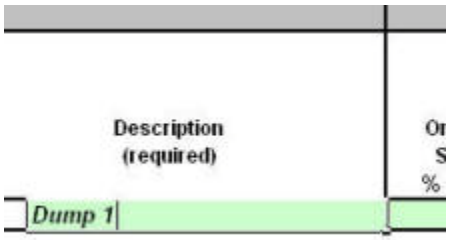
Basic Data Entry

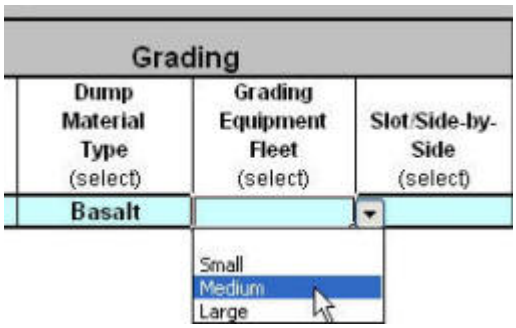
The Model workbook is divided into different worksheets (sheets). Each contains information related to a particular type of facility or activity. Generally, the first two (or three) tables on each worksheet are for user input while the other tables contain the results of the Model calculations.



Cells formatted for user input are colored green, cyan and yellow. All other cells are locked and cannot be accessed by the user. The only exception to this are the User sheets, which are unlocked to allow user input and formatting to all cells.

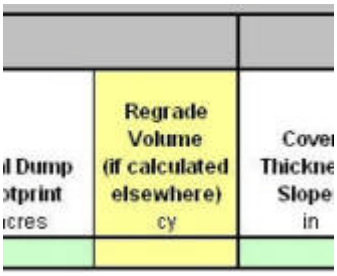
Green cells are formatted for direct input. These cells are unlocked and can accept any type of input (text, numbers, etc.) However, the data entered will affect the resulting calculations and entry of an inappropriate data type, (e.g. text vs. number) will cause errors in the calculations dependent on these cells.

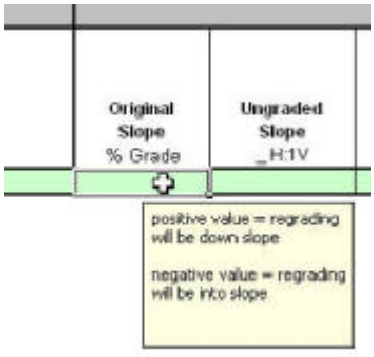




Cyan cells contain drop-down lists that allow the user to select from a list of valid options. Input of data other than the options presented in the drop-down lists is not allowed in these cells.

Yellow cells are used for direct user input that overrides calculated values for earthwork volumes or areas (i.e. regrade volumes or areas for revegetation). These override cells allow the user to input volumes or areas manually within the various modules, allowing control over a few limitations of some of the volume calculations (see Waste Rock Dumps and Heap Leach Pads)





Where appropriate, data entry tips are provided when a cell is selected. When the user selects a cell containing a data entry tip with the mouse or by pressing the Tab key, a small text box will appear with useful information regarding what is expected or providing additional information on the form of the data expected. As shown here, the data entry tip indicates that by entering a positive value in this cell, the Model will assume that the slope will be graded down the underlying slope. The Model will assume that the slope will be regraded into an opposing slope if a negative value is entered in this cell.

Basic Model Commands

The Model has been designed to use a consistent set of commands for similar actions regardless of the type of facility being modeled. Where applicable, buttons to add facilities, clear the user data and delete a facility are included at the top or along the

right side of a spreadsheet. Each of these buttons performs the same function on each worksheet where it is found.

Adding Facilities

The Model is distributed without any rows (facilities) in any of the worksheets. To add new facilities to a worksheet, press the Add button at the top of the worksheet. On some sheets containing multiple facility types, the buttons may be at the right of the table. After selecting the **Add** function a dialogue box will appear asking how many facilities you wish to add. If there are already facilities on the worksheet, then a second dialogue box will appear asking the user to select the row above which the new facilities should be added. If the user selects "add to end", then the new facilities will be added to the bottom of the table(s). After the user selects "**Yes, Continue**", the Model will add the requested rows to all of the tables in the work worksheet. Selecting "**No, Cancel**" on any dialogue box will cancel the action without adding any new facilities.

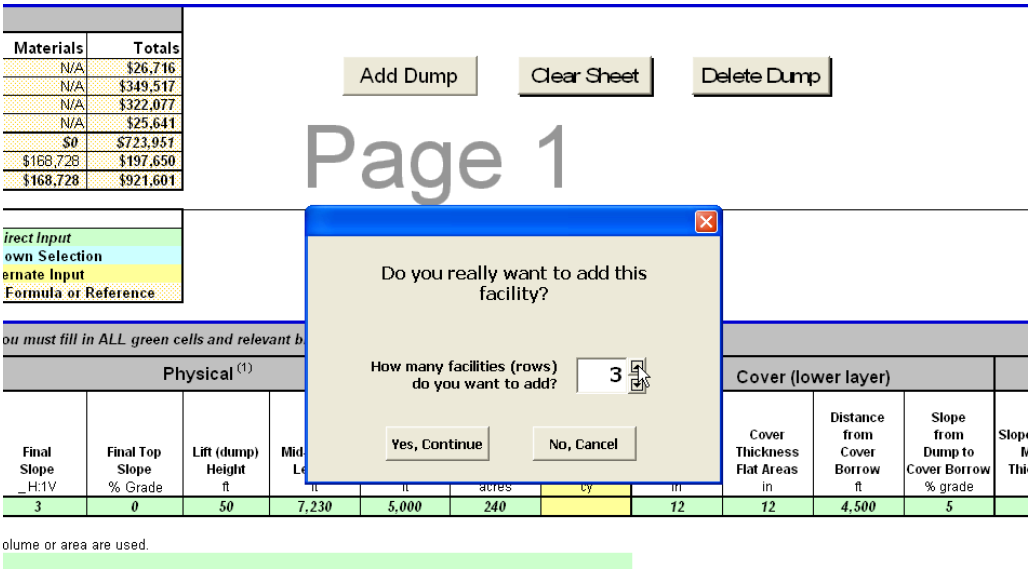


Figure 9 - Adding Facilities

Clearing User Data from a Worksheet

By selecting the **Clear Sheet** button from the top (or side) of a worksheet, all user input information will be deleted from a worksheet, but all of the rows will remain in the tables. Use this option to empty the data from a worksheet without removing the lines for the facilities. This action cannot be undone.

Deleting Facilities

Selecting the Delete button at the top (or side) of a worksheet will delete facilities (rows) from a model. In the current Model versions (v. 1.0 to 1.2) the user can only delete one facility at a time. A dialogue box will prompt the user to select the facility to be deleted and after the user confirms the deletion, the corresponding rows will be deleted from each of the tables on the worksheet.

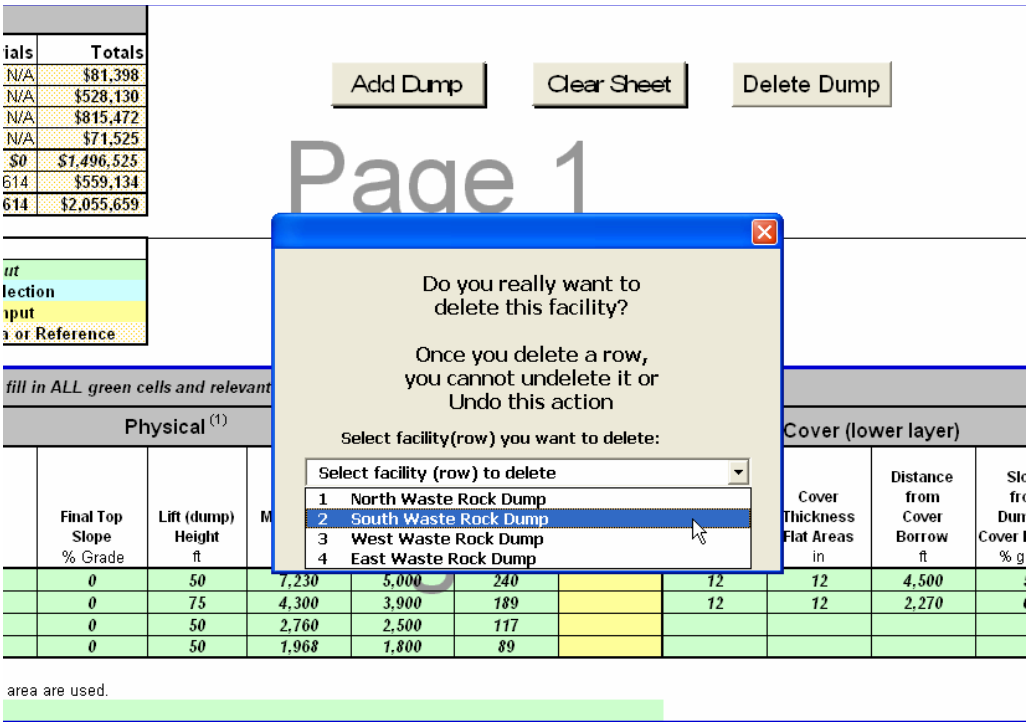

Add Dump
Clear Sheet
Delete Dump
Page 1
Do you really want to delete this facility?
Once you delete a row, you cannot undelete it or Undo this action
Select facility(row) you want to delete:
Select facility (row) to delete
1 North Waste Rock Dump
2 South Waste Rock Dump
3 West Waste Rock Dump
4 East Waste Rock Dump
Physical (1)
Cover (lower layer)
Final Top Slope % Grade
Lift (dump) Height ft
Cover Thickness Flat Areas in
Distance from Cover Borrow ft
area are used.

Figure 10 - Deleting Facilities

Entering Data into Worksheets

The procedure for entering data into each of the worksheets has been standardized in the Model to the highest degree possible. However, the Model requires slightly different user input for each of the facility types to calculate closure costs and allows a great deal of flexibility in how the cost estimate for each facility is approached.

Property Information

The **Property Information** worksheet contains information describing the property, the cost data basis and the units of measure. This worksheet has a combination of direct user entry, option buttons and drop-down user selections. It also contains information on the last data file imported into the Model. The *File Name*, *Date*, *Cost Data Type* (Standardized or User), *Units of Measure*

NOTE:
If the version of the Model is not approved for use in the State of Nevada (USA), then a message will appear at the top of the Property Information (see **Figure 11**).

and *Author/Source* of the last *Data File* imported into the Model are shown at the top of the page. The bottom of the page contains information on the project and the cost estimate including the *Project Name* and *Date*, *Units of Measure*, *Type of Project* (small exploration, large exploration or mine operation), *Land Status* (Private, Public or Public/Private) and the selected *Cost Basis* (see **Chapter 4 – Setting Up Cost Data Files**).

For projects in the USA, the three project types shown on the **Property Information** worksheet determine which indirect costs are automatically included on the **Cost Summary** worksheet. The user can also override these selections if appropriate.

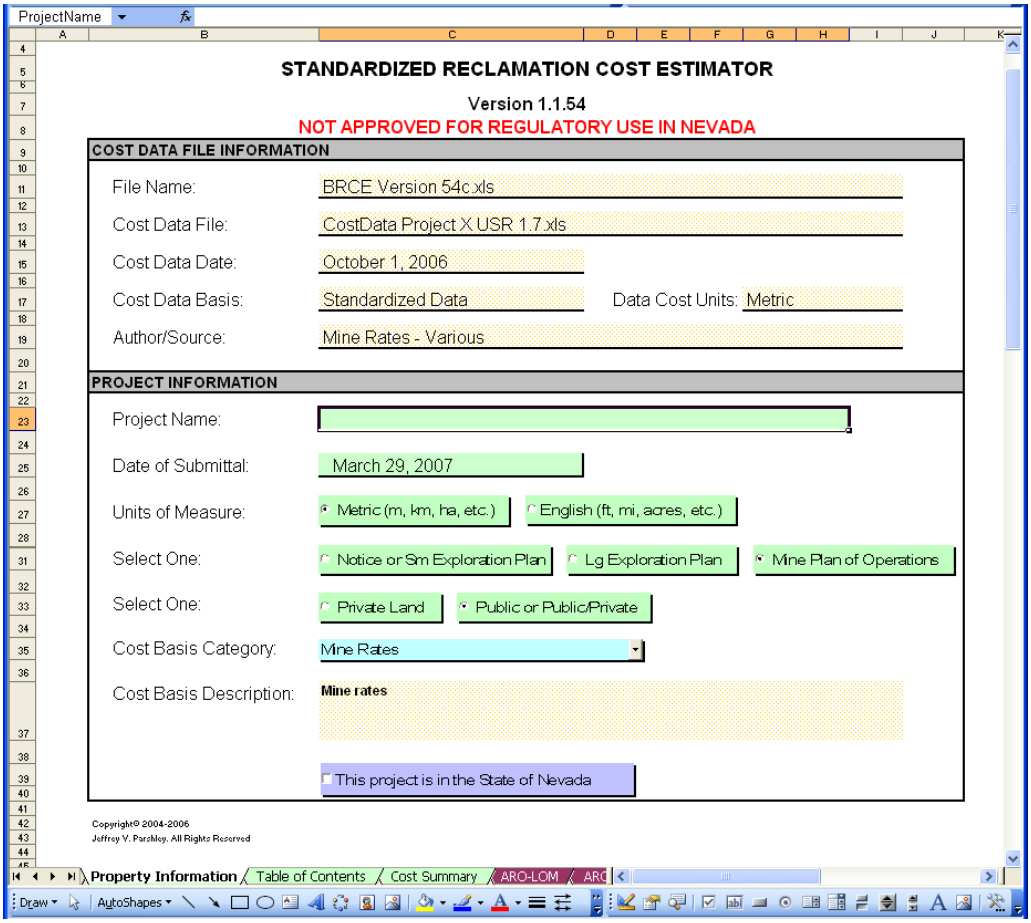

ProjectName
STANDARDIZED RECLAMATION COST ESTIMATOR
Version 1.1.54
NOT APPROVED FOR REGULATORY USE IN NEVADA
COST DATA FILE INFORMATION
File Name: BRCE Version 54c.xls
Cost Data File: CostData Project X USR 1.7.xls
Cost Data Date: October 1, 2006
Cost Data Basis: Standardized Data
Data Cost Units: Metric
Author/Source: Mine Rates - Various
PROJECT INFORMATION
Project Name:
Date of Submittal: March 29, 2007
Units of Measure: Metric (m, km, ha, etc.) English (ft, mi, acres, etc.)
Select One: Notice or Sm Exploration Plan Lg Exploration Plan Mine Plan of Operations
Select One: Private Land Public or Public/Private
Cost Basis Category: Mine Rates
Cost Basis Description: Mine rates
This project is in the State of Nevada
Copyright© 2004-2006
Jeffrey V. Parshley. All Rights Reserved
Property Information
Table of Contents
Cost Summary
ARO-LOM
Draw
AutoShapes

Figure 11 - Property Information Worksheet (non-Nevada version shown)

Exploration Data

Because the scale of exploration disturbances is generally smaller than that for mine operations, the Model utilizes different equipment and labor fleets (crews), and productivities for exploration activities. Therefore, data for exploration projects or exploration activities at mining operations is entered into two exploration worksheets

in the Model. The first worksheet, **Exploration**, is used to estimate the cost of exploration drillhole abandonment and reclaiming exploration trenches. The **Expl. Roads & Pads** worksheet contains information on the reclamation of exploration roads and drill pads.

Exploration Drillholes

The exploration drillhole abandonment module on the **Exploration** worksheet allows users to estimate the cost of plug exploration drillholes using a number of methods including top plugs, grouting, grout + backfilling and cementing. If no method is selected, then no cost is calculated. If the water depth is above the bottom of the hole and grout + backfilling is selected as the *Hole Plug Method*, then the Model calculates the amount of grout required to fill the hole from the bottom to the distance above the water table defined in the *Minimum Seal Above Groundwater Table* distance entered in at the top of the worksheet.

An option is included to allow for removal of casing for situations where casing is set in pre-drilled holes or for navigational drilling.

Multiple holes can be added on a single line using an average depth and limiting the number of lines required to estimate all drillhole abandonment costs.

Exploration Trenches

Backfilling and seeding of exploration trenches assumes that the trenches were created using a bulldozer to push material to the ends of the trench, and then backfilled using a bulldozer to push the material back into the trench. The volume of the trench is calculated based on the information provided by the user according to the diagrams and information shown on the worksheet. Although the trench may be on a slope, the Model assumes that the dozer push is on level ground because ½ of the volume would be pushed uphill and ½ would be pushed down hill.

Exploration Roads and Pads

The Model can calculate the cost for reclaiming exploration drill roads on flat surfaces or slopes. On flat areas (*Underlying Ground Slope* = 0%) the Model will assume that no road regrading is required, unless the user enters a volume in the *Regrade Volume* override cell. On slopes the Model handles the regrade volume calculations for both exploration roads and pads using the same basic formulae. Essentially, the Model considers an exploration road to be a cut-to-fill road (see **Figure 12** and **Figure 13**) and a drill pad to be wide section of the road. The basic formula for exploration road volume calculation is as follows:

Regrade Volume of Pads = (Cross-sectional area of pad x 1.2 (swell)) x Length of each Pad x No. of Pads

Regrade Volume of Road = [(Cross-sectional area of road x 1.2 (swell)) x (Length of Road – Length of each Pad x No. of Pads)

Total Regrade Volume = Regrade Volume of Pads + Regrade Volume of Road

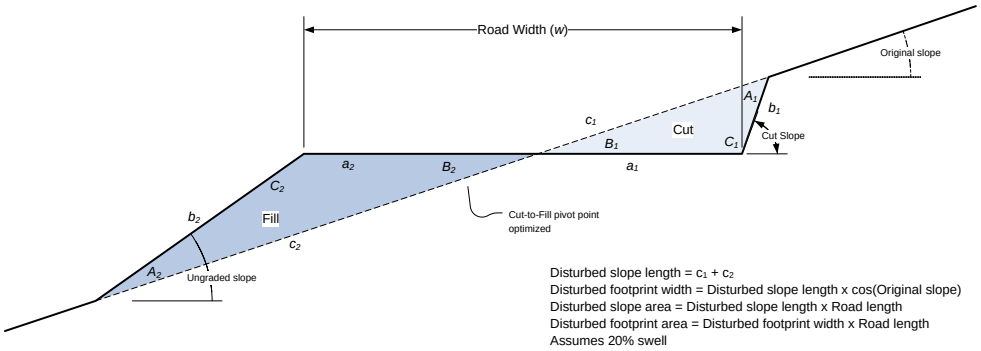


Figure 12 - Road Recontouring Calculation

This greatly simplifies the input requirements to estimate the cost of reclaiming a large number of exploration roads and drill pads. **Figure 12** and **Figure 13** show the basic input requirements to estimate reclamation costs for exploration roads on a sideslope.

Figure 13 - Exploration Road Inputs

The surface area disturbed for use in the calculation of cover and seeding quantities is the surface area as defined by: *area = (slope length disturbed by cut + fill) x total length*

On flat areas, the roads may still require some regrading and/or scarifying.

On slopes of greater than 30% grade, the Model assumes that the volume of any sumps needed for drilling fluids is included in the pad regrading volumes. On slopes of less than 30% grade the Model uses input from the user in the *Individual Sump Volume* cell to estimate the total volume of sumps requiring backfilling.

TIP: Minimize the required data input for exploration road reclamation by creating exploration zones of similar slope.

When entering data for a large number of exploration drill roads and pads first subdivide the exploration into zones of similar slope (see **Figure 14**). Then enter the average slope for that zone, the average road width, the total length of drill roads + pads, the total number of pads and the dimensions of the pads as a single row in the worksheet. Include any pads not on roads or on roads to remain after reclamation in the number of pads and include the total length of these pads in the total length of drill roads + pads.

This can greatly reduce the total amount of lines required to estimate the total exploration road and pad reclamation cost without significantly sacrificing the accuracy.

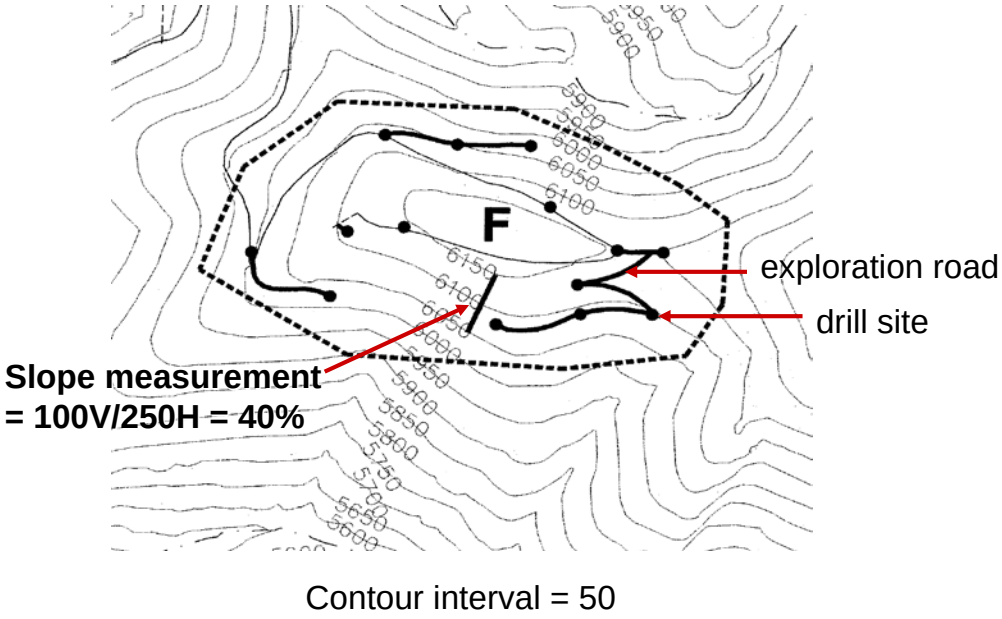


Figure 14 - Exploration Road Zones

Mine Facilities

In general, mine facilities are larger and require larger equipment and different crews to perform reclamation and closure. Therefore, the Model uses different crews and methods than for exploration project to calculate the reclamation and closure of mine facilities.

Although there are a number of different types of facilities included in the Model, the Model estimates the closure and reclamation costs of each using similar or identical calculation methods, to the best degree possible. For example, the method for calculating the loading, hauling and placing of cover on all facilities uses exactly the same formulae.

Waste Rock Dumps and Heap Leach Pads

The Model uses nearly identical formulas and subroutines to estimate costs for waste rock dumps and heaps. Therefore, they are discussed together in this section.

The only difference between the **Waste Rock Dump** and **Heap Leach** modules are the additional tables in the **Heap Leach** module used to calculate the cost of placing drainage pipe and drain rock in the solution channels

surrounding the heap before regrading.

Heap and dumps are typically constructed as side hill, valley fill or valley floor configurations. With limited input data from the user the Model can estimate reclamation and closure costs for all of these configurations.

First, the Model calculates the volume of material requiring regrading and the final surface area of the facility by using the basic geometry of the facility and the methods described in **Chapter 2**. The input required to perform these calculations are shown on **Figure 15** and **Figure 16** and includes the height, underlying (original ground) slope, ungraded slope, the mid-bench length and the final facility footprint. The Model also allows the user to input a final grade for the top of the facility, but typically this will only slightly affect the regrading volume calculations.

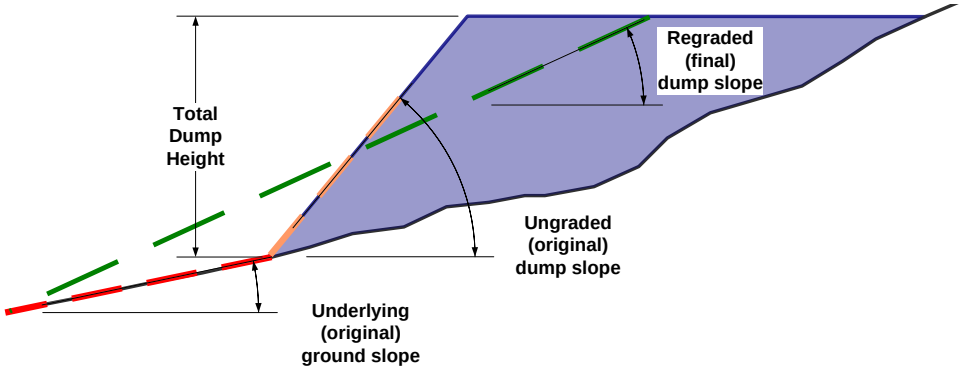


Figure 15 - Waste Rock Dump or Heap Slope Inputs

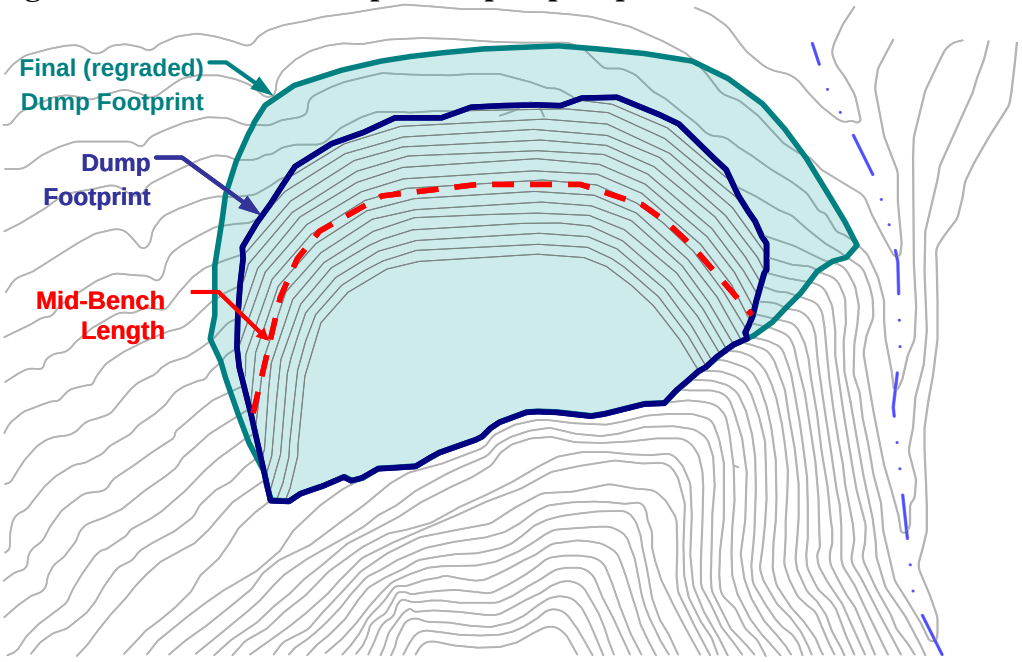


Figure 16 - Regrading Volume Inputs

In the simplest configuration, the data required to calculate waste rock dump and heap leach closure costs is fairly straightforward. However, the configuration of a waste rock dump or heap leach facility can affect the accuracy of the cost calculation the minimum data required is all that the user enters. Because the Model does not limit the user to using a single line item for each waste rock dump and heap leach, a complex dump can be subdivided into sections to increase the overall accuracy of the Model calculations for the facility.

An example waste rock dump is shown in **Figure 17**. This dump comprises two separate lifts with an irregular footprint and varying lift heights. It has also been partially reclaimed and the current slope angles on the bottom lift are at their final configuration. After reviewing the current dump configuration, the user can see that the dump can be better represented in the Model if it is divided into four areas based on the height of the lifts and the underlying ground slope (the upper lift has an underlying slope of zero because it is located on top of the lower lift). Areas 1 and 2 represent the upper lift and are separated primarily because of the different height of the lift in those two areas. Areas 3 and 4 have different lift heights as well, but also have different existing slope angles with the entire slope of Area 4 having been regraded to the final slope. Using these divisions, the dump can now be broken into four sections, each input into separate line in the **Waste Rock Dump** module (see **Figure 18**).

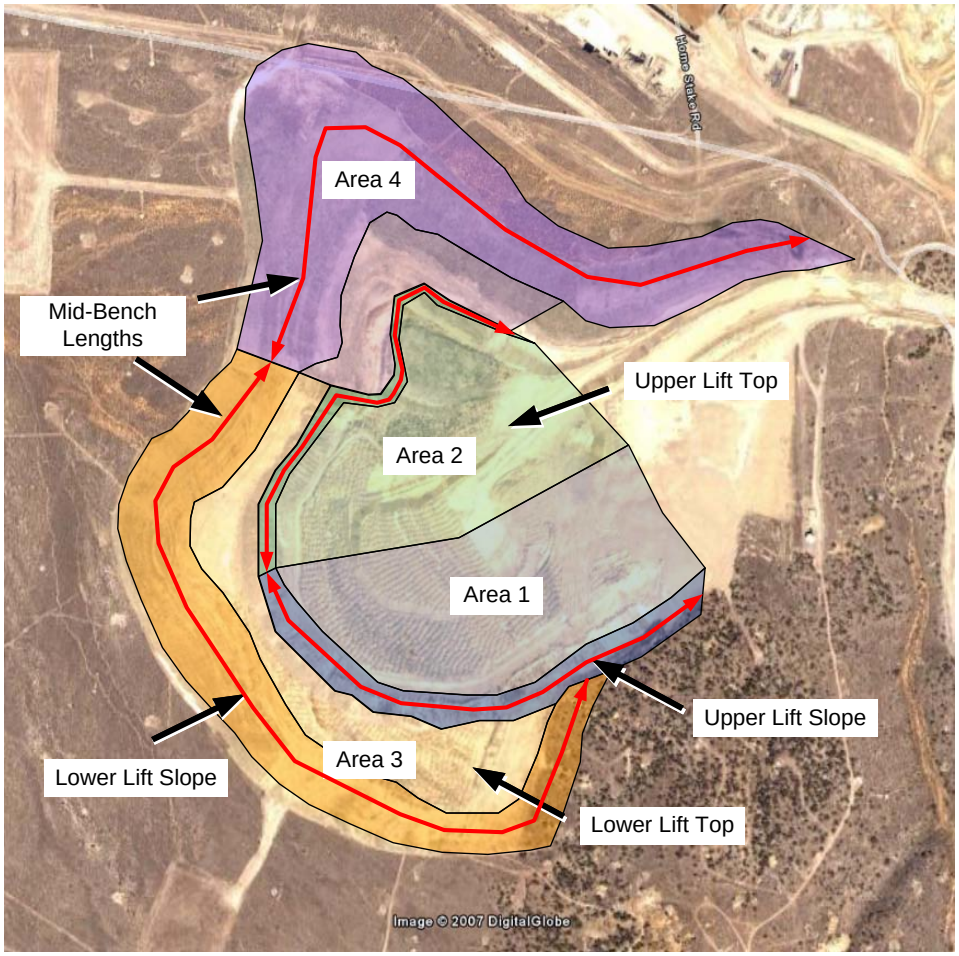


Figure 17 - Example Waste Rock Dump

The *Final Footprint Area* for the upper lift areas must be estimated based on the approximate location of the regraded toe. The *Final Footprint Area* for the lower lift areas should reflect the area of the lower lift that will not be covered by the upper lift in its final configuration.

24	Waste Rock Dumps - User Input								*You must fill in ALL green cells in this section for each dump, lift or dump category*		
25				Physical							
26		Description (required)	GIS Code (optional)	Underlying Ground Slope	Ungraded Slope	Final Slope	Final Top Slope	Lift (dump) Height	Mid-Bench Length	Average Flat Area Long Dimension (ripping distance)	Final (Regraded) Dump Footprint
27				% Grade	_ H:1V	_ H:1V	% Grade	m	m	m	ha
29	1	*Area 1*	*SWRD-1*	*0.0*	*1.3*	*3.0*	*0*	*10.0*	*1000.0*	*1000.0*	*12.00*
30	2	*Area 2*	*SWRD-2*	*0.0*	*1.3*	*3.0*	*0*	*15.0*	*1500.0*	*1000.0*	*14.00*
31	3	*Area 3*	*SWRD-3*	*15.0*	*3.0*	*3.0*	*0*	*20.0*	*1850.0*	*1700.0*	*22.00*
32	4	*Area 4*	*SWRD-4*	*10.0*	*4.0*	*4.0*	*0*	*25.0*	*2350.0*	*2000.0*	*17.00*
35		(1) All Physical parameters must be input even if manual overrides for volume is used.									

Figure 18 - User Input for Example Waste Rock Dump

In this example, the accuracy of the calculations could be increased by further subdividing the lower lift areas. Area 4 could be divided into two areas to delineate the northeast slope that has already been covered by topsoil (see darker area). This would allow the user to the Area 3 could be further subdivided to separate the portion of the slope that has been partially regraded and the portion of the slope that has not yet been regraded (southeast corner).

The decision on how much detail is appropriate is a function of the information available, the purpose of the cost estimate and the required level of accuracy required for that purpose.

Important Note

When working with narrow waste rock dumps or heap leach pads, the Model may overestimate the total volume of regrading required if the cross-sectional cut areas overlap from one side of the dump to the other.

Tailings Impoundments

The **Tailings** module addresses the two main components of a tailings impoundment separately (see **Figure 19**). The embankment is treated in a manner similar to that of waste rock dump and heap leach slopes. The tailings surface is addressed separately as a near horizontal, irregular surface. The Model has options for regrading, cover and revegetation for both areas of an impoundment.

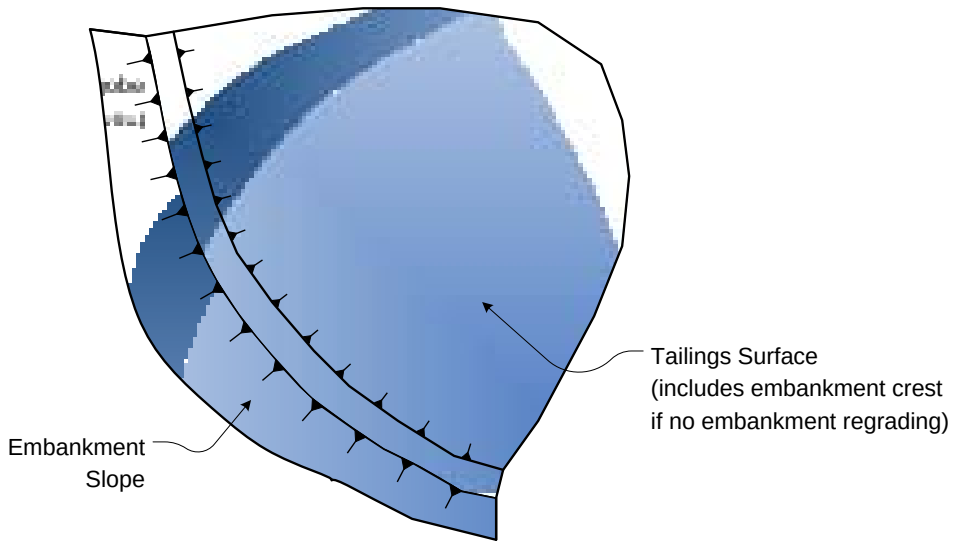


Figure 19 - Tailings Impoundments

In estimating the closure costs for tailings impoundments, the Model uses some of the calculations used to calculate the costs for waste rock dumps and heap leach pads. In particular, the inputs required and calculations performed to estimate the cost to regrade a tailings embankment are the same as needed to

estimate the cost to regrade a waste rock dump or heap leach pad (see **Figure 20**). As with waste rock dumps, if the embankment has been constructed in a manner that facilitates regraded by raises, then the cost to reclaim each raise can be estimated separately.

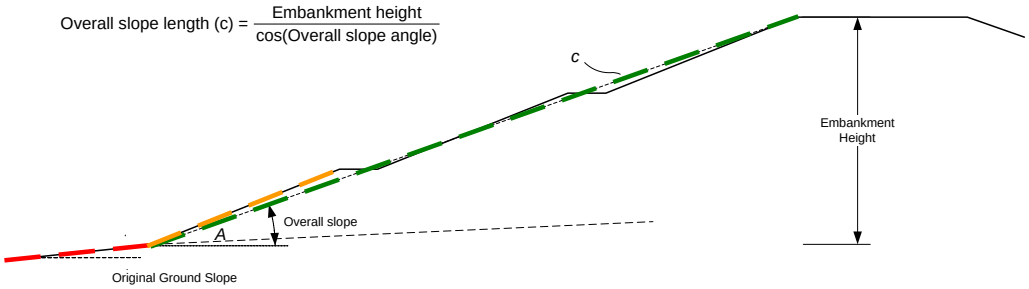


Figure 20 - Tailings Embankment Parameters

Many tailings embankments are constructed at their final configuration and may only require final cover placement and revegetation. As noted in **Chapter 2**, in order for the Model to calculate the surface area of a facility such as a tailings embankment, the same geometric dimensions needed to calculate a regrade volume will still be needed as user input.

The surface of a tailings impoundment may also require regrading as part of closure. However, because the final configuration of the tailings will vary greatly depending on the deposition of tailings in the final years of production, there is no simple method for calculating the volume of material that will require regrading at closure. Therefore, the user must calculate this volume separately and input it directly into the Model.

Roads

The **Roads** module uses nearly identical calculations to those used by the **Exploration Roads and Pads** module to calculate the cost of regrading of other roads. The only significant difference between these two modules is the types of equipment used and the addition of safety berms to the regrade volume calculation in the **Roads** module.

The *Haul Road Safety Berms* table allows the user to account for the volume of safety berms constructed along the side(s) of a road. The Model will use the berm dimensions input by the user to calculate the berm volumes for each road entered. Because the berm length is separate from the road length, the user can enter the same length as the entire road or a shorter length if the berm only extends along a portion of the road. Depending on the situation and regulatory requirements, berms may be required on one or both sides of the road, and the Model allows the user to indicate if there are berms on one or both sides of the road.

Where roads cross drainages requiring significant regrading, the user should calculate the volume of regrade separately. This volume can then be entered directly in to the *Regrade Volume* override column.

In situations where only ripping is the only required reclamation treatment, the user should enter 0 into the *Regrade Volume* override column and then enter the ripping parameters as needed.

TIP: Where roads are located on flat or nearly flat ground, either enter the regrade volume directly or use a very low underlying (original) slope angle to estimate a minimal regrade.

Pits

The **Pits** module contains options for placing and revegetating a pit perimeter berm or pit ramp berms to preclude access into a pit. If pit backfilling is required, use the Haul Material module (see **Chapter 6 – How Do I Calculate Pit Backfilling**).

Three options exist for the berm construction method; Haul & Place, Excavate and Dozer.

Option	Description
Haul & Place	Assumes a truck and loader operation to haul material to the berm location. The material is end dumped and shaped with a small dozer.
Excavate	Assumes that an excavator will excavate a trench and place the excavated material along the edge of the trench closest to the pit to create a berm.
Dozer	Assumes a dozer will push material along a berm in a direction perpendicular to the pit rim (and berm) to create a berm from the pushed material. The average push length assumed to be approximately 33m/100ft.

The Nevada version only allows the user one berm construction option – Dozer.

Revegetation of the berms uses the same options as all other facility types. Ripping the berm is not included as an option.

Underground Openings

The **Underground Openings** worksheet includes options for closing both vertical (shaft) and horizontal (adit)/subhorizontal (decline) openings to underground workings. Generally closure methods allowed involve construction of barriers or backfilling.

Productivities for adit plugs, barricades and bat gates are calculated from actual work recorded in the western U.S. Backfill productivities are based on material hauling costs with special (small) fleets and have been generally validated with actual work in the western U.S. The productivity and material costs for construction of a reinforced concrete shaft cap were adopted from Means[1].

Adits

Closure of adits assumes that a barricade, gate or backfill is required. Barricades are assumed to be concrete walls, with or without rock backfill from the barricade to the opening. Gates, designed to allow egress and ingress of bats may be appropriate for certain situations. Backfill may be the primary closure method or used in conjunction with a barricade. Options for backfill include rock backfill or expanding foam.

The volume of a barricade or backfill is computed from the user input parameters. If a combination of a cement barricade and rock backfill is selected, the Model assumes that the adit opening will be filled with backfill from the opening to the cement wall. Similarly, if expanding foam is used, the Model assumes that a minimum of 5m/15ft of backfill is required to protect the foam plug.

Shafts

The two basic options for closing shafts are the construction of a concrete reinforced cap. If a cap is selected, it is assumed to be an elevated 1-way beam and reinforced concrete slab 45cm/18in thick. A minimum of 3m/10ft of backfill is assumed as cover on top of the cap. Backfill is assumed to be performed by trucks and loaders, with a small dozer to push the material into the shaft.

Haul Material

The **Haul Material** worksheet is a module that calculates the cost of hauling any type of material from one location to another using trucks or scrapers. The fleets used for these calculations include loading equipment and a small dozer to spread the material moved. This module uses the same basic formulae as the routines used to calculate the cost for hauling cover and growth material materials in many of the other modules. However, it also includes options for crushing and screening the material prior to placement, and compaction of the placed material.

If screening or crushing are selected, an option is also provided to define the amount of volume loss occurs during the process. The Model then increased the total material hauled to account for this loss prior to placement.

The **Haul Material** worksheet that can be used for a number of purposes, including but not limited to:

- **Pit backfilling**,
- **Multi-layer covers** with compacted and/or crushed or screened layers,
- **Hauling construction materials** for various uses, or
- **Transport of mine waste** to new location.

For use in calculating pit backfilling costs, this module allows the placement of additional cover and topsoil after backfilling. If infiltration reduction is required, then compaction of the backfill can be included by selecting "Yes" in the *Compact After Placement?* cell.

This module has options to include costs for crushing, screening and/or compacting the primary material hauled. If crushing or screening options are selected, the user must also input the additional distance that the material will be hauled from the crushing/screening plant. Another option lets the user define the quantity of material delivered to the crusher/screen that is lost due because it is either too small or two large for the intended use. If compaction is selected, the Model assumes that a vibratory roller will be used for compaction. Costs for crushing, screening and compaction are based on per volume costs included in the **Misc. Unit Cost** worksheet. Up to two additional layers can be added by using the cover and growth material options in the same manner included in many of the other modules.

For all of the hauling fleets, this module also has an option to limit the maximum size of the hauling fleet. This can be useful if a small fleet is available to haul a large volume of material. If the user enters a non-zero, positive integer in the *Maximum Fleet Size* cell for any of the materials (primary material, cover, growth material), the Model will use this input value to override the standard formulae that calculate a loader limited or dozer limited fleet size for truck/loader or dozer/scraper fleet, respectively.

Foundations and Buildings

The **Foundations & Buildings** module provides a simple method to estimate the cost to demolish buildings, foundation slabs and foundation walls. It also provides options to place cover and/or growth media, and scarify and revegetate building areas.

There is no option to perform regrading in this module, so if regrading is required, use the Yards module to estimate that cost.

The **Foundations & Buildings** module uses basic cost/volume and cost/area calculations to estimate building, and wall and slab demolition costs. The source of the demolition productivities and crews is Means Heavy Construction[2] (used by permission). The cost data imported into the Model from a cost data file are combined with the productivities to produce the cost/volume cost/area rates for demolition. These productivities, crews and rates are shown on the **Misc. Unit Costs** worksheet.

The user input required by this module includes: the dimensions of the buildings, the type of building construction, the heights and thicknesses of the walls, concrete slab demolition method, the building area (including surrounding areas such as parking lots associated with the buildings, and the thickness of cover and topsoil for the areas. Input such as dimensions, wall thicknesses, and cover and topsoil parameters are input as number directly in to the first user data table in the module. Information such as the type of building and wall construction and slab demolition method are selected from a list of available options. The building types are based on the building types included in the demolition section of Means Heavy Construction.

When entering the *Building Area Footprint*, areas surrounding and associated with the buildings can be included (see **Figure 21**). The Model uses this footprint area when calculating the cost of placing cover and growth media, scarifying and revegetation for the building. Another method to account for these areas is to include these areas in the **Yards** module.

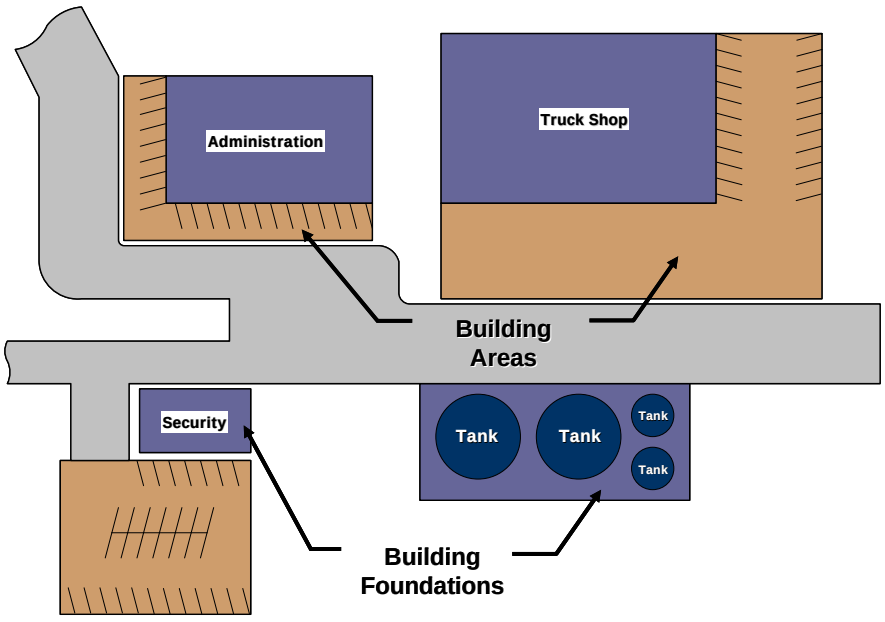


Figure 21 - Buildings and Foundations

If the Break and Bury option is selected as the slab demolition method, the Model assumes that an excavator equipped with a hydraulic hammer will be used to break the slab before burying.

Other Demolition and Equipment Removal

The **Other Demo & Equipment Removal** module provides another option for the user to include the cost of demolition and removal of buildings, structures, and equipment that does not require the input of building or area dimensions. This module

TIP: By entering formulae in the labor and equipment unit cost cells linking these cells to fleet unit (hourly) costs for an appropriate fleet in the Fleets module these costs will be automatically updated as new equipment and labor rates become available.

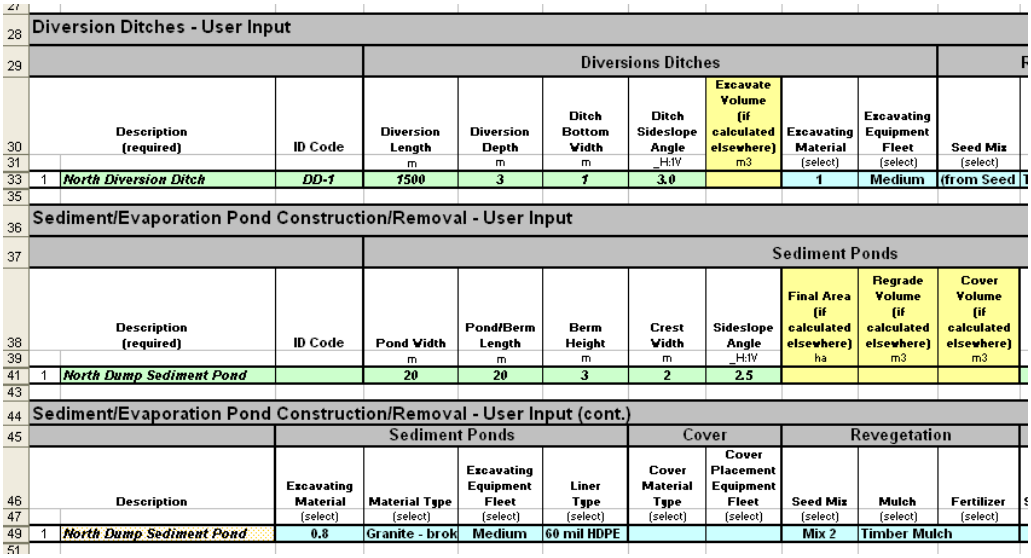
is intended to be used with external calculations or experience regarding the cost of or time required for demolition or equipment removal activities. The user must enter data into the *Location*, *Quantity* and various unit cost fields on each line for the Model to estimate costs for these activities.

Diversion Ditches and Sediment Ponds

The **Sediment & Drainage Control** module is intended to calculate the cost of installing diversion ditches and installing or removing sediment ponds. Diversion ditches are assumed to have a trapezoidal cross-section and be constructed using an

TIP: The Buildings and Foundations module can be used to estimate the cost of tank demolition. Enter the tank diameter in both the length and width columns and select a steel building type. This will slightly overestimate the volume, but not significantly.

excavator. The excavation volume is either calculated based on dimensions input by the user or a volume input by the user in the *Excavate Volume* override cell (see **Figure 22**).



Diversion Ditches - User Input

		Description (required)	ID Code	Diversions Ditches: Diversion Length (m)	Diversion Depth (m)	Ditch Bottom Width (m)	Ditch Sideslope Angle (_H:1V)	Excavate Volume (if calculated elsewhere) (m3)	Excavating Material (select)	Excavating Equipment Fleet (select)	Seed Mix (select)
1	North Diversion Ditch	DD-1	1500	3	1	3.0		1	Medium	(from Seed

Sediment/Evaporation Pond Construction/Removal - User Input

		Description (required)	ID Code	Sediment Ponds: Pond Width (m)	Pond/Berm Length (m)	Berm Height (m)	Crest Width (m)	Sideslope Angle (_H:1V)	Final Area (if calculated elsewhere) (ha)	Regrade Volume (if calculated elsewhere) (m3)	Cover Volume (if calculated elsewhere) (m3)
1	North Dump Sediment Pond		20	20	3	2	2.5			

Sediment/Evaporation Pond Construction/Removal - User Input (cont.)

		Description	Sediment Ponds: Excavating Material (select)	Material Type (select)	Excavating Equipment Fleet (select)	Liner Type (select)	Cover: Cover Material Type (select)	Cover Placement Equipment Fleet (select)	Revegetation: Seed Mix (select)	Mulch (select)	Fertilizer (select)
1	North Dump Sediment Pond	0.8	Granite - brok	Medium	60 mil HDPE			Mix 2	Timber Mulch	

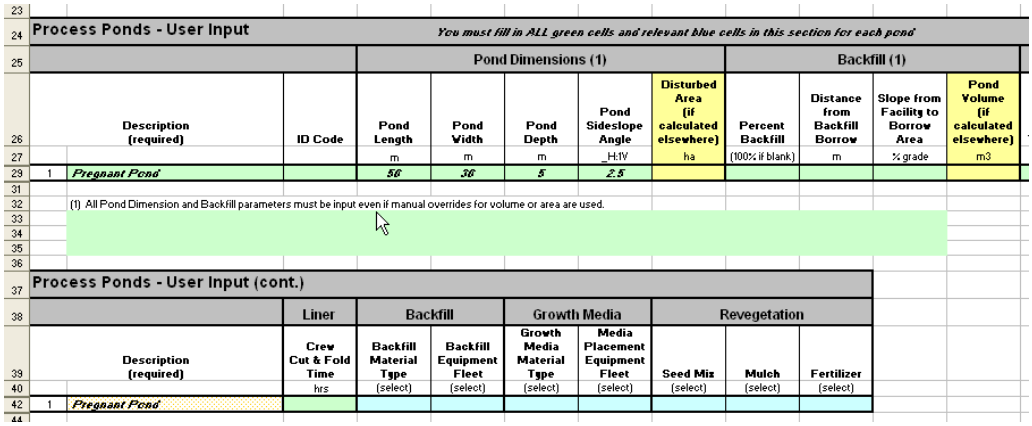
Figure 22 - Diversion Ditches & Sediment Ponds

Because the module assumes that bulldozers would be used to either construct or remove a sediment pond, and the same basic calculations are required to estimate volumes and work hours for either option, this module can be used to estimate the cost of either removing or installing a sediment pond. The Model currently assumes that sediment ponds will be constructed across a surface water drainage by pushing material with a bulldozer to create a berm. The disturbed area, dozing volume and cover volume calculations can be overridden by the user. An option to install a 60mil HDPE liner in a sediment pond is available (see **Figure 22**).

Process Ponds

Estimating the cost of backfilling, liner removal and revegetation of process ponds requires limited information including the dimensions of the pond, the methods and parameters for backfilling and placement of growth media, and revegetation (see **Figure 23**). Once the pond dimensions are entered in to the first table of the **Process Pond** module, the volume is calculated using the formula shown on the worksheet and in **Figure 1**. If needed, override cells are provided for both the *Disturbed Area* and *Pond Volume*.

Two methods of backfilling are provided, dozers or a truck and loader fleet. The cost of hauling backfill, if a truck and loader option is selected, uses the same cycle time and productivity calculations used for other material hauling activities (e.g. cover or growth media placement. Unless otherwise specified by the user, the Model assumes that the pond will be completely backfilled.



Process Ponds - User Input — *You must fill in ALL green cells and relevant blue cells in this section for each pond*

			Pond Dimensions (1)					Backfill (1)			
	Description (required)	ID Code	Pond Length	Pond Width	Pond Depth	Pond Sideslope Angle	Disturbed Area (if calculated elsewhere)	Percent Backfill	Distance from Backfill Borrow	Slope from Facility to Borrow Area	Pond Volume (if calculated elsewhere)
			m	m	m	_H:1V	ha	(100% if blank)	m	% grade	m3
1	*Pregnant Pond*		*50*	*30*	*5*	*2.5*					

(1) All Pond Dimension and Backfill parameters must be input even if manual overrides for volume or area are used.

Process Ponds - User Input (cont.)

		Liner	Backfill		Growth Media		Revegetation		
	Description (required)	Crew Cut & Fold Time	Backfill Material Type	Backfill Equipment Fleet	Growth Media Material Type	Media Placement Equipment Fleet	Seed Mix	Mulch	Fertilizer
		hrs	(select)	(select)	(select)	(select)	(select)	(select)	(select)
1	*Pregnant Pond*								

Figure 23 - Process Pond User Input

The cost of cutting and folding a pond liner is based in the *Crew Cut & Fold Time* parameter input by the user and assumes that two laborers and a small excavator with operator comprise the removal crew.

Landfills

The **Landfills** module provides a method for calculating the cost of reclaiming landfills associated with solid waste disposal, including construction debris. This module is nearly identical to the **Waste Rock Dumps** module except that it does not calculate a regrade volume and assumes a flat area. The user must enter a regrade volume and a disturbance area for the cost calculations to work properly.

Yards, Etc.

The **Yards, Etc**. module was designed to allow the user to include reclamation costs for miscellaneous disturbance areas such as ready lines, laydown yards, disturbed areas unrelated to another facility and facilities such as parking areas not associated with a particular building. This module is essentially identical to the **Landfills** module and requires the same user input.

Waste Disposal

The **Waste Disposal** module has three separate sections for disposal of solid, hazardous and hydrocarbon wastes. The options for each type of waste are based on typical disposal methods.

Solid Waste

Two options exist for *Solid Waste* disposal; on-site and off-site. On site disposal assumes that the waste will be loaded and hauled to an on-site landfill. The closure of the landfill should be included in the **Landfills** module. If solid waste is hauled from the site, the Model assumes that roll-off containers will be used. The rental rates and

haulage costs for off-site disposal are based on unit costs included in the cost data file imported by the user.

Hazardous Waste

For the purposes of the Model, hazardous waste is any waste material requiring special handing, transportation or disposal. The *Hazardous Waste* tables assume that hazardous waste will be removed from the site. The method of packaging and transporting is dependent on the type and quantity of waste. Options for both liquid and solid hazardous wastes are included. The transport and disposal costs for hazardous waste are based on unit costs included in the cost data file imported by the user. Testing of unknown materials is not included, but can be included using the *Other Costs* option in the **Misc. Costs** module.

Hydrocarbon Contaminated Soils

Methods for disposal of Hydrocarbon Contaminated Soils include off-site disposal and on-site treatment. If the material is hauled off site, the unit costs are based on data included in the cost data file imported by the user. If the materials are treated on-site, the costs include hauling to the treatment area and treatment assuming simple landfarming (biotreatment) techniques. Closure of the treatment facility is not included in this module but can be added in the **Yards, Etc.** module.

Well Abandonment

The **Well Abandonment** module provides options for closing cased wells or borings. This module has been optimized based on the assumption that when abandoned wells must not be open to the surface or have the potential to cross-connect aquifers.

Two types of wells are included based on the well construction methods. Production, dewatering and infiltration wells assume that the casing is steel and that hydraulic seals are not included in the annular space except at the very top of the well. Monitor wells may be constructed with steel or plastic casing, but are assumed to have a hydraulic seal immediately above the screened section and the annular space above the seal is filled with low permeability materials such as bentonite grout or cement.

The thickness of the surface seal for the well and the minimum seal required above groundwater when grout is used are set by the user in the cells provided at the top of the worksheet (see **Figure 24**).

The productivity for the different well abandonment methods are based on actual field data from the State of Nevada, USA provided by mine operators and drilling companies. The labor, equipment and material unit rates for hole plugging are included in the cost data file imported by the user.

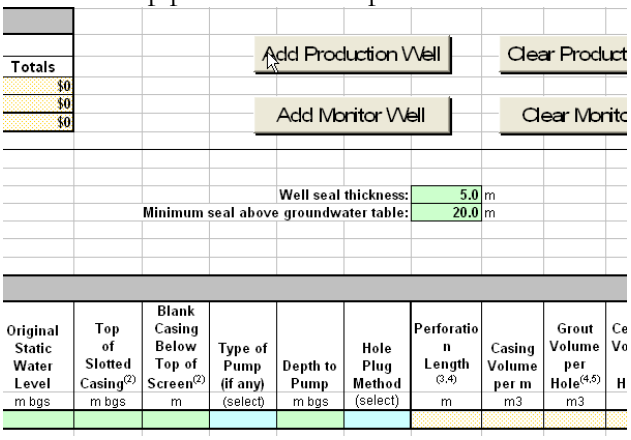
Figure 24 - Well Seal Thicknesses

The cost for abandoning both types of wells are similar with production well abandonment including options to remove a pump and perforate the well casing above the water table to when using grout to allow the grout to enter the annular space. Both well types have options for several well plugging methods including a top plug only, grout, a cement plug and nothing.

Grout volumes are calculated based on 2.0 and 1.25 times the well casing volume for production wells and monitor wells, respectively. The additional volume allows for migration of grout into the annular space and formation. Because production wells are typically larger diameter and deeper, the weight of the grout material will force more grout into the formation that a smaller, shallower monitor well.

Misc. Costs

The **Misc. Costs** module includes a number of additional costs for which productivities have been calculated using published data or information available from contractors. Many of these are linear works such as fence installation and removal, culvert and pipe removal and power line removal. An option for riprap placement is also included. The last table in the module, *Other Costs* can be used by the user to input the cost for any activity for which labor, equipment and material rates are available.



The *Fence Installation*, *Fence Removal Costs*, *Culvert Removal*, *Pipeline Removal* costs, and *Rip-Rap and Rock Lining* costs are all based on crews and crew productivities from Means Heavy Construction. The labor and equipment rates for these are based on the cost data file imported by the user. The *Powerline and Substation Removal* costs are estimated from unit costs included in the cost data file imported by the user.

Monitoring

The **Monitoring** module includes options for reclamation monitoring and maintenance costs, and ground and surface water monitoring. These costs include labor and equipment for reclamation activities as well as labor costs for preparing annual reports.

Reclamation Maintenance

Maintenance costs for reseeding and erosion of topsoil are estimated based on the percent of surface area and topsoil volume, respectively (see **Figure 25**). The Model provides the total surface area and topsoil volumes, and the user inputs the percent of each that is estimated to require maintenance during the closure monitoring period.

The *Total Revegetation Surface Area* is calculated as the sum of the surface areas included in all of the other modules. Because the calculation of total surface area does not differentiate areas to be seeded and areas that may not be seeded, the user may need to reduce the percentage requiring reseeding if a significant amount of the total surface area included in the Model does not require seeding, or has been successfully seeded and will not require reseeding.

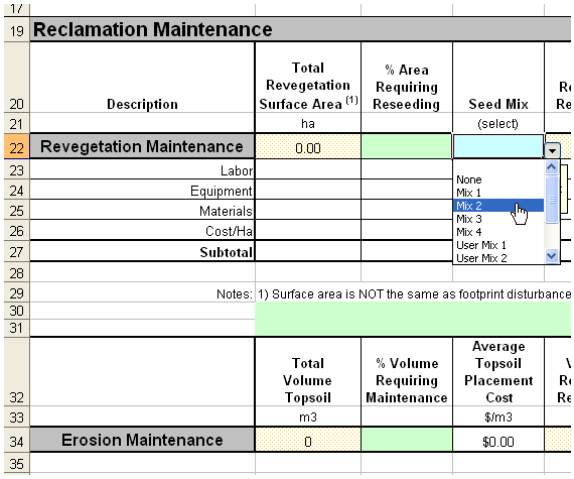


Figure 25 - Reclamation Maintenance

The Model also estimates the average topsoil placement cost based on the average of the average costs by facility weighted by the volume of topsoil required by each facility. The average topsoil placement cost for all facilities is used in the **Monitoring** module to estimate the cost of replacement of topsoil respectively (see **Figure 25**).

A table of surface areas and topsoil volumes is shown by facility type and total for all facilities in the **Reclamation Quantities** module. This module also calculates the average costs for topsoil placement by facility type and for all facilities.

Reclamation Monitoring

The **Reclamation Monitoring** section of the **Monitoring** module allows the user to specify the cost of post-closure monitoring of the revegetation and geotechnical stability of the site. Periodic field work and reporting options for both vegetation monitoring and monitoring by an engineer are provided. The user enters the work hours, days per year and the length of the monitoring period for a field geologist or engineer and a revegetation specialist (see **Figure 26**).

40	**Reclamation Monitoring**				
41	**Description**	**Hrs/Day**	**Days/Year**	**Number of Years**	**Rate**
42					$/hr
43	**Field Work**				
44	Field Geologist/Engineer	*10*	*5*	*5*	$140
45	Range Scientist	*10*	*2*	*5*	$140
46	**Reporting**				
47	Field Geologist/Engineer	*4*	*1*	*5*	$140
48	Range Scientist	*8*	*2*	*5*	$140
49	**Subtotal**				
50	**Travel**				
51		**Hrs/Trip**	**Trips/Year**	**Years**	**Truck Cost**
52		hr			$/hr
53	Travel	*6*	*2*	*5*	$2.08
54	**Subtotal**				
55					

Figure 26 - Reclamation Monitoring

Note

Users of the SRK/Barrick Model may wish to use the **Closure Planning** module to track annual monitoring costs because that module allows the user to include and document a number of different types of reports and studies.

Geochemical Monitoring

The **Monitoring** module also includes options for collecting and analyzing rock and water samples. Sampling labor, travel, analytical and reporting costs are calculated based on the time required for each event, the number of events per year and the length of the monitoring period (see **Figure 27**).

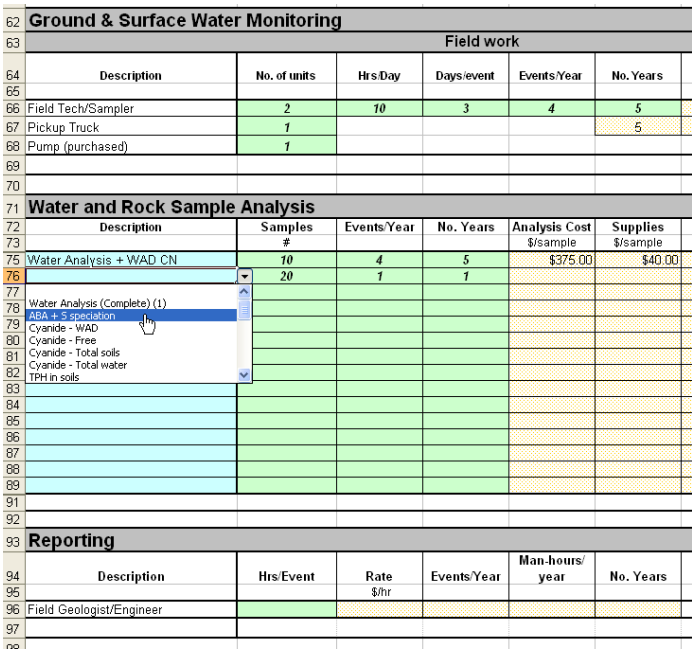


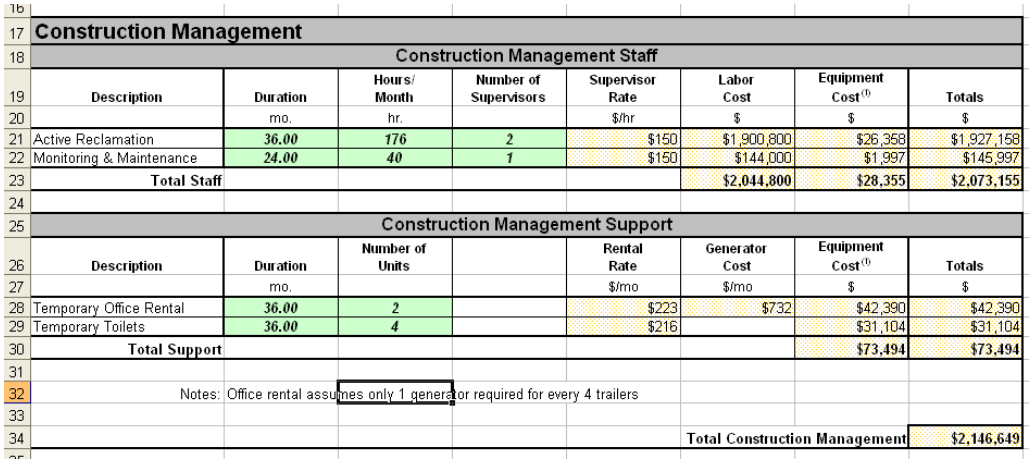
Figure 27 – Rock & Water Monitoring

TIP: To enter a one-time sampling event in the Water and Rock Sample Analysis section enter the number of samples and then enter a "1" in both the Events/Year and No Years cells.

Construction Management

The **Construction Management and Road Maintenance** module allows the user to add general management, construction support and maintenance costs necessary to complete the closure project. Costs included in this module include the cost of project supervision, temporary power and office space and road maintenance crews. Each section of the module provides options for varying the amount of management and maintenance based on the phase of the closure work (i.e. active closure, and monitoring and maintenance).

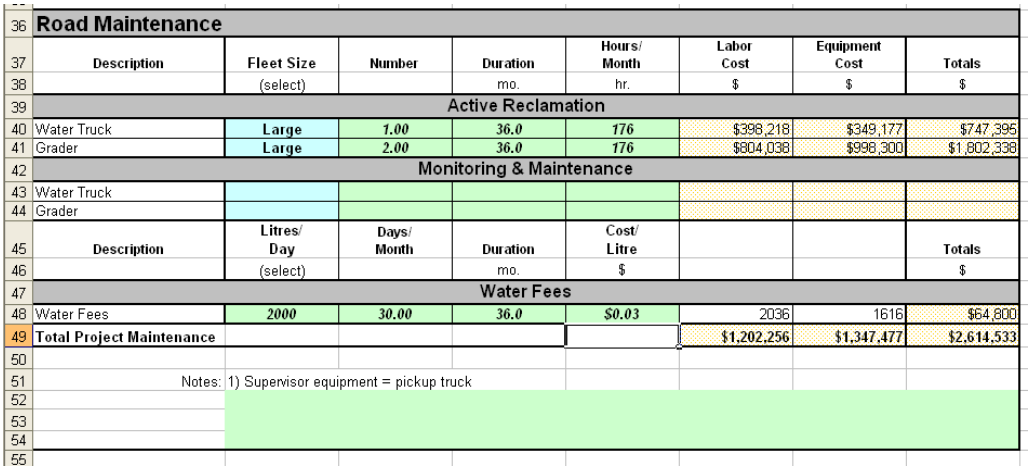
The *Construction Management* table includes options for the number of project supervisors, temporary office space and toilets (see **Figure 28**). Generator power for the office is automatically added based on the number of office trailers selected.



Construction Management							
Construction Management Staff							
Description	Duration	Hours/ Month	Number of Supervisors	Supervisor Rate	Labor Cost	Equipment Cost[1]	Totals
	mo.	hr.		$/hr	$	$	$
Active Reclamation	36.00	176	2	$150	$1,900,800	$26,358	$1,927,158
Monitoring & Maintenance	24.00	40	1	$150	$144,000	$1,997	$145,997
Total Staff					$2,044,800	$28,355	$2,073,155
Construction Management Support							
Description	Duration	Number of Units		Rental Rate	Generator Cost	Equipment Cost[1]	Totals
	mo.			$/mo	$/mo	$	$
Temporary Office Rental	36.00	2		$223	$732	$42,390	$42,390
Temporary Toilets	36.00	4		$216		$31,104	$31,104
Total Support						$73,494	$73,494
Notes: Office rental assumes only 1 generator required for every 4 trailers							
					Total Construction Management		$2,146,649

Figure 28 – Construction Management

In the *Road Maintenance* table, the user can select the size and number of pieces of equipment used for road maintenance (see **Figure 29**). In addition, the time required for the fleet can be entered by the phase of closure. If water for dust control must be purchased, this can also be entered in this module.



Road Maintenance								
Description	Fleet Size	Number	Duration	Hours/ Month	Labor Cost	Equipment Cost	Totals	
	(select)		mo.	hr.	$	$	$	
Active Reclamation								
Water Truck	Large	1.00	36.0	176	$398,218	$349,177	$747,395	
Grader	Large	2.00	36.0	176	$804,038	$998,300	$1,802,338	
Monitoring & Maintenance								
Water Truck								
Grader								
Description	Litres/ Day	Days/ Month	Duration	Cost/ Litre			Totals	
	(select)		mo.	$			$	
Water Fees								
Water Fees	2000	30.00	36.0	$0.03	2036	1616	$64,800	
Total Project Maintenance					$1,202,256	$1,347,477	$2,614,533	
Notes: 1) Supervisor equipment = pickup truck								

Figure 29 - Road Maintenance

TIP: To estimate the Duration for which Construction Management and Road Maintenance are required for a project, review the various modules to determine the total time required to complete all activities. Concurrent activities and the number and types of fleets mobilized to the site should be considered. If a Reclamation and Closure Schedule is available for the project, use this.

Solution (Water) Management

The **Solution Management** module provides options for calculating costs for some basic solution or water management activities. This module does not provide standardized costs for water treatment, estimate draindown times or include a water balance module as all of these calculation are highly site specific. However, this module does include placeholders for some typical activities associated with closure solution and water management. These include:

- **Pumping**;
- **Forced Evaporation**;
- **Water Treatment**; and
- **Decontamination**.

The **Pumping**, **Forced Evaporation** and **Decontamination** tables include calculations to estimate the cost to pump water from one location to another using Manning's Equation and standard hydraulic formulae. These formulae require user input for the diameter and material type of the pipe, the static head, the required flow and other parameters needed to estimate the energy required. Combining this information with the unit cost of energy either entered in the **Reclamation Materials** module or overridden by the user at the top of the module, labor rates, and pumping schedule and user-entered capital costs, the **Solution Management** module can estimate the total capital and operating (pumping cost) for these activities.

The **Forced Evaporation** option also allows the user to define the pressure required at the end of the pipe. This information is usually available from the manufacturer of the evaporation system or can be obtained from operation data.

The **Water Treatment** option requires the user to estimate the treatment costs externally. By applying the user supplied capital and operating costs to the treatment quantity and duration, the Model calculates a total water treatment costs (not including pumping. Because the labor required for different treatment methodologies and site specific conditions can vary greatly, the user must enter the labor crew size for this option.

Important Note

If additional pumping is required for water treatment either to transport water to the treatment facility or discharge water from the treatment facility, the user will need to use the Pumping option to account for those costs.

The **Decontamination** option is provided as a placeholder for the management and disposal of decontamination rinse water. As required by in jurisdictions and by the

Cyanide Code[3] decontamination of process facilities may require the rinsing of containers, equipment and piping used to convey process solutions. The **Decontamination** option in this module allows the user to account for the capital, labor and pumping costs associated with rinsing and disposal of the rinse water.

Closure Planning

The **Closure Planning** module has options for including costs for studies, reports, engineering and permitting for closure. Activities entered into this module should include any expected or required plans or studies. These costs are entered as lump sums based on quotes, estimates or existing information. Each table includes a column to document the type of activity and a column for comments.

Other User

The **Other User** module provides an alternative method of including miscellaneous closure costs in the **Summary Costs** and **ARO-LOM** modules. The user must supply the capital labor and operating costs for each line item. The *Comments* field allows the user to provide addition information for each line item (e.g. the basis of the cost estimate or the

Although the user can use the *Other Costs* table in the Misc. Costs module to include miscellaneous costs, the **Other User** module carries each item included in this worksheet as a separate line item in the **ARO-LOM**. In addition, the *Cost Type* cell for each item in the **Other User** module can be used to ensure that the each of the Other User costs are included in the correct section of the **Summary Costs** worksheet.

General and Administration

The general and administration (**G & A**) module includes costs that would be incurred by the operator during closure, but would not necessarily be incurred by a third-party closing the site. This distinction is important because that these costs are not included in the ARO costs (see **ARO-LOM Scheduling**) unless the user overrides that default condition in the **ARO-LOM** module.

The types of costs in the **G & A** module include *Property Holding Costs*, *Security and Maintenance* and *Administration*. The options in this module allow the user to input a *Type* of cost, the *Frequency* of the cost the *Cost per Payment* and the *Number of Payments*.

Human Resources

The **Human Resources** module allows the user to include additional staff required during closure that may not be included automatically in the other modules. For example, if long-term security or caretaking is required, those costs can be included in this module. The user can enter different job groups and vary the number of employees by the closure year. The closure years shown in these tables correspond to the *Closure Year 1* included in the **ARO-LOM** module and are

automatically scheduled into that module based on the information provided in this module.

User Sheets

There are twenty **User Sheets** at the end of the Model that can be used to perform any additional calculations needed to estimate closure costs. A standard header has been entered into each of these sheets containing basic project data.

The cells in these sheets are unlocked and can contain enter any standard Excel data type or formula. For example, these sheets could be used to provide a mobilization cost or detailed calculations entered in the *Other Costs* table in the **Misc. Costs** module.

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[1] Means Heavy Construction Cost Data 2006. Reed Construction Data, RSMeans, Kingston, MA., Copyright © 2006

[2] Ibid.

[3] 2006 International Cyanide Management Institute, 1200 G Street, NW, Suite 800, Washington, DC 20005, USA

Chapter

6

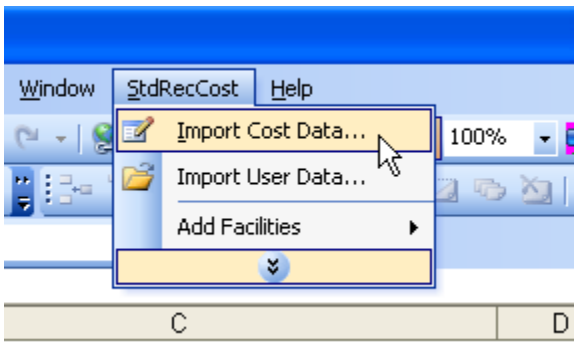
How do I . . . ?

Although the Model was designed to provide a standardized approach to reclamation and closure cost estimating, unique requirements of specific projects often require the use of different approaches to using the Model.

For simple projects, little additional effort is necessary to produce a viable cost estimate with the Model. However, many projects have unique requirements that necessitate the need for special techniques using the Model or external calculation using other tools or methods. Most of the modules in the Model allow the user to implement different approaches to calculating the reclamation costs. The most appropriate method in each instance will depend on the configuration of the facility and the requirements for reclamation and closure.

… Import Cost Data in to the Model

Cost data is imported into the Model using the "Import Cost Data" option from the custom StdRecCost menu (see **Figure 34**). The cost data files may be supplied by a corporate or regulatory organization, or created by the user as described in **Chapter 4 – Setting Up Cost Data Files.** If the cost data file changes, you will need to re-load the cost data to update the Model.



The data must be in the exact format contained in the user cost data file (Cost Data USR.xls) or a standardized cost data file available from your company or local regulatory agency. Links to some of these regulatory web sites are also listed on the Downloads page of the NVBond.org web site (www.nvbond.org).

Figure 30 - Import Cost Data Menu

The standardized versions of the cost data file are locked and cannot be edited by the user. These files are typically maintained and updated by corporations or regulatory agencies responsible for reviewing and approving reclamation cost estimates for financial reporting or surety purposes. The cost data cells in the user cost data file are unlocked to allow users to enter their own cost data (e.g. mine costs).

… Import Data from a Previous Model File

As the Model evolves and new versions becomes available the user may need to update existing cost models by upgrading to a new version. In Versions 1.1 and earlier, the only option is to manually add the number of facilities needed in each Module and then manually cut and paste the information from the old file to the new file.

TIP: When performing a manual cut-and-paste operation, be sure to use the Paste Special/Values option from the Edit menu in Excel. This will ensure that cell formats are not changed.

A new import capability was added in Version 1.2 to aid in ease of transferring your data into the latest version of the Model. To access the import routine the user needs to select the "Import User Data" option from the custom StdRecCost menu (see **Figure 35**). This option allows the user to import data from some of the previous version into the latest version. It does not work with all versions of the Model and will check to see if the file the selected import file is the proper version.

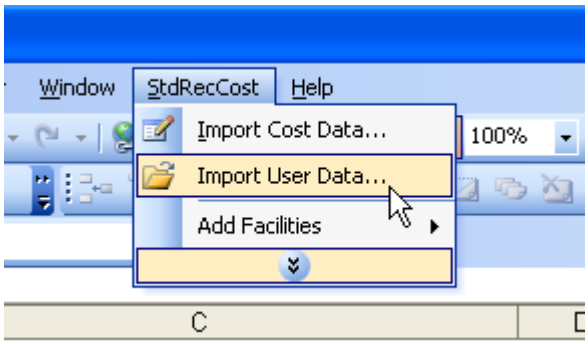


Figure 31 - Import User Data Menu

Important Note

The import routine will behave variably depending on the particular version being loaded. Some modules will require editing and a few will only partially load due to some differences in some of the version/build being loaded. Therefore, **it is critical** that the user carefully check each worksheet after importing the data.

… Calculate Closure of Multi-Lift Dumps

Multi-lift dumps can be estimates in a number of ways depending on how you need to treat the reclamation of the dump. Because the Model does not limit the user to using a single line item for each waste rock dump and heap leach, a complex dump can be subdivided into sections to increase the overall accuracy of the Model calculations for the facility.

Fist determine what the lift heights are, if the current slopes (both underlying ground and lifts) are the same for each lift, if any or all lifts need to be regraded, seeded, ripped, fertilized or any other specific reclamation activities. If all the heights, slopes and reclamation activities are likely to be the same you can enter as a Multi-lift (additive). If any of these are different the lift will need to be treated as a Multi-lift (separate).

Multi-lift (additive)

A multi-lift (additive) dump can be input into the Model as a single line. You will need to determine the mid-bench length of each lift and then you can add them together to get the total mid-bench length (see **Figure 36**). All of the lifts on the dump can then be entered as a single line with a single lift height and the total mid-bench length.

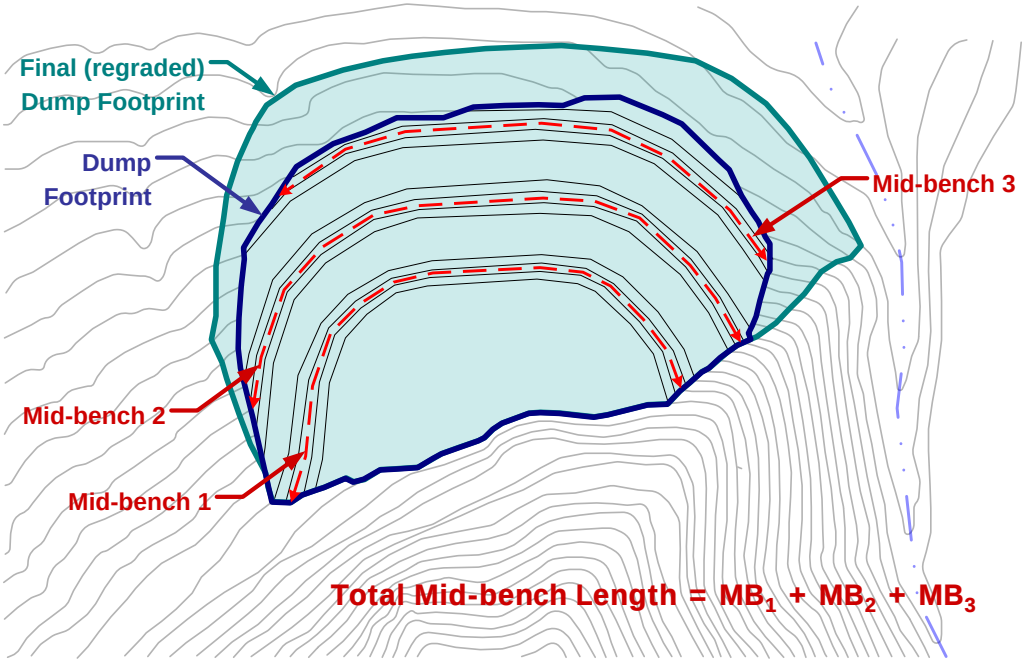


Figure 32 - Multi-Lift Slope Inputs (additive)

Multi-lift (separate)

A dump with different lift heights or on steep ground will need to be entered as a multi-lift (separate) dump. In this situation, you need to treat each lift separately in the Model. You will need to determine the mid-bench length and the footprint associated with each lift, or area (see **Figure 37**). The best method to do this is to start with the top lift and determine the final footprint area and other input for that lift. Then, using the toe of the final footprint of the top lift as the upper bound of the footprint for the next lift, repeat the process until you have included all of the lifts.

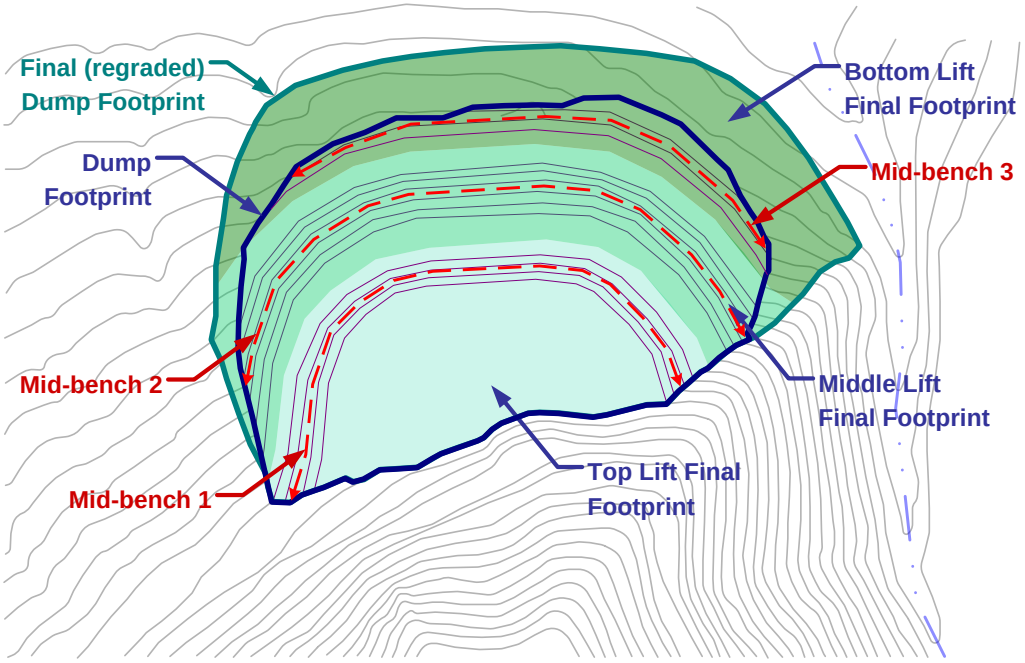


Figure 33 - Multi-Lift Slope Inputs - Separate

Another example of a complex waste rock dump is given in **Chapter 5** and shown on **Figure 17**. The decision on the approach taken and how much detail is appropriate entering the data for each dump will be site and facility specific and highly dependent on the information available and the level of accuracy required from the cost estimate..

… Create a Cover with More than Two Layers

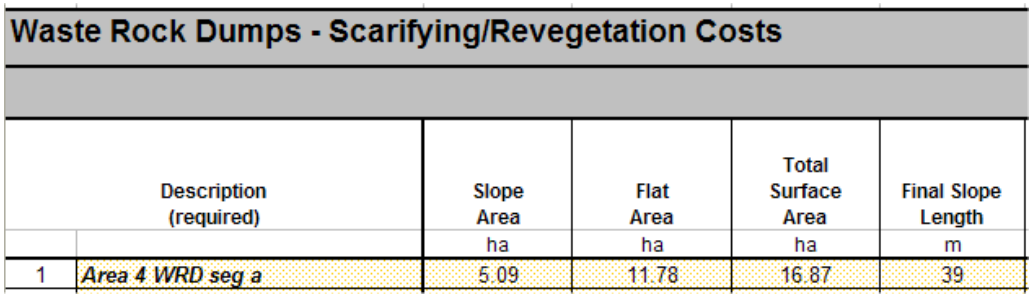
To create a cover with more than two layers you need to utilize the **Haul Material** worksheet separately or in association with the facility worksheets. Begin by inputting the geometry of the facility you wish to cover in the specific facility worksheet (i.e. WRD, Heap leach etc). Using the cover and growth material columns you can allow the Model to calculate volumes of each cover you will need to haul and place. To find the volume scroll down the worksheet until you come to *Cover and Growth Media Costs* (see **Figure 38**).

Waste Rock Dumps - Cover and Growth Media Costs

		Cover (lower layer)				
	Description (required)	Cover Volume	Cover Replacement Fleet	Fleet Productivity	Number of Trucks/ Scrapers	Total Fleet Hours
		m3		LCM/hr		
1	Area 4 WRD seg a	17,137	Cover Material!	Cover Material	Cover Material	over Materia

Figure 34 - Waste Rock Dumps – Cover and Growth Media Costs

Another approach to determining the volume required would be to use the surface area from the facility worksheet and multiply that area by the desired thickness of the cover. Surface areas can be found by scrolling down the facility worksheet until you come to *Scarifying/Revegetation Costs* (see **Figure 39**). You can then transfer the volumes and Surface areas to the **Haul Material** worksheet.



Waste Rock Dumps - Scarifying/Revegetation Costs

	Description (required)	Slope Area	Flat Area	Total Surface Area	Final Slope Length
		ha	ha	ha	m
1	Area 4 WRD seg a	5.09	11.78	16.87	39

Figure 35 - Waste Rock Dumps - Scarifying/Revegetation Costs

The first two cover layers can be entered into the facility worksheet with any additional cover layers being entered into the **Haul Material** worksheet. If only three layers are required the user can enter all of these in the **Haul Material** worksheet. Each line in the **Haul Material** worksheet will allow you to add another three cover layers – the first being the material you haul and then a cover and growth media over the hauled material.

The worksheet can now be filled out as any other worksheet, with surface area (as calculated above), average ripping distance of surface area, volume of material to haul (as calculated above), distances to the source material, and slope to source material. Cover and growth material can also be entered.

This module has options to include costs for crushing, screening and/or compacting the primary material hauled. If crushing or screening options are selected, the user must also input the additional distance that the material will be hauled from the crushing/screening plant. If compaction is selected, the Model assumes that a vibratory roller will be used for compaction. Costs for crushing, screening and compaction are based on per volume costs included in the **Misc. Unit Cost** worksheet. Up to two

additional layers can be added by using the cover and growth material options in the same manner included in many of the other modules.

When working with more than two cover layers you will need to be aware of what you have entered into the facility worksheet and the **Haul Material** worksheet so that you do not duplicate costs (e.g. scarifying/ripping, which may only need to performed once).

… Incorporate Cyanide Code Compliance

Compliance with the Cyanide Code requires that a closure cost estimate addressed all activities necessary to properly decontaminate and decommission process facilities that have come into contact with cyanide solutions during operations. Most of these activities are covered in the main modules of the Model. Others may require the use of the **Misc. Costs**, **Other User** or **User Sheets**.

The Solution Mgmt. Sheet also contains useful options for Cyanide Code compliance. The *Pumping* of water, *Forced Evaporation* for disposal of water, *Water Treatment* and *Decontamination* options in this module provide a method to facility Cyanide Code compliance with the Model.

… Calculate Pit Backfilling

In Version 1.1.1 the best method to estimate the cost of pit backfilling is at use the backfill option in the **Process Ponds** module to estimate the load/haul/place cost for backfilling a pit. In later versions, Pit backfilling is best handled in the **Haul Materials** worksheet in the Model.

For use in calculating pit backfilling costs, this module allows the placement of additional cover and topsoil after backfilling. If infiltration reduction is required, then compaction of the backfill can be included by selecting "Yes" in the *Compact After Placement?* cell.

… Add Mobilization and Demobilization Costs

The cost for mobilization and demobilization of equipment to a site is usually calculated separately and added to the total costs. Typically, mobilization costs are estimated for each piece of equipment that will be used for the closure work.

The current versions of the Model do not include a standard calculation for mobilization of equipment, but these costs can be estimated by the user in a User worksheet or using an external model. One such model is the **2007_mob_demob.xls** Excel workbook available from the Nevada Division of Environmental Protection (NDEP) website (http://ndep.nv.gov/bmrr/cost.htm).

In the current Model versions, the user must manually determine the number of each type of equipment that must be mobilized. To assist the user in this, each of the main worksheets calculates and reports the number of each type of equipment that will be used for each line item. By reviewing this information, the user can determine the maximum number of each type of equipment needed to perform the work documented in the Model. In general, the maximum number of pieces of each type equipment will represent the amount of equipment that will be mobilized. However, if activities requiring the same equipment will be performed simultaneously at different locations then the total pieces of equipment requiring mobilization should account for multiple fleets of the same equipment.

For example, if one of the waste rock dumps needs four scrapers to haul topsoil and placement of cover on a tailings impoundment at the same time requires three scrapers, then the total number of scrapers that must be mobilized is seven.

Important Note

Caution should be used when selecting the *optimize* option for fleet selection in many of the sheets. If this option is selected the Model determines which of the standard fleets will perform the required activity for the lowest cost. However, indiscriminate use of the *optimize* option can result in the multiple types of fleets being selected when in reality, the operator or a contractor is likely to only mobilize one fleet to perform the same activity at multiple locations on the site. This could lead to an overestimate of mobilization costs.

… Add Site Specific Costs for Materials

There may be times that a site specific material cost is not included in the cost data worksheet. These costs can be entered into the material costs tab within the Model. Costs can be entered for *Revegetation* materials, *Mulch*, *Fertilizers*, and *Monitoring Costs*.

To enter site specific costs you will need to enter the cost into the green cells under the appropriate headings making sure to enter an appropriate description, units and cost (see **Figure 40**). A WAD Cyanide cost of $125 per sample. Below the direct entry (green) cells for the specific costs there are another set of green direct entry cells where you need to enter the source of the costs you have just entered.

These costs will then be available in the blue dropdown list in the appropriate cells throughout the Model.

	Monitoring Costs		
82	Description	Units	Cost/unit
83			
84	Monitor Well Pump	ea.	$2,140.00
85	Sampling Supplies	ea.	$5.00
86			
87	Water Analysis (Profile I) (1)	ea.	$300.00
88	Leach Test (MWMP) w/ analysis	ea.	$370.00
89	ABA + S speciation	ea.	
90	WAD Cyanide in water	ea.	
91	Water Analysis (Profile II) (1)	ea.	
92			
93			
94			
95			
96			
97			
98			
99			
100			
101			
102	*WAD Cyanide*	*ea.*	*$125.00*
103			
104			
105			
106			
107			
108			
109			
110			
111			
112	(1) WET Labs, Reno, Nevada (7/2006)		

Figure 36 - Example of User Cost Data

… Get the StdRecCost Menu Back

If you open more than one copy of the model at a time and then close one, the **StdRecCost** menu option at the top of the Excel screen will disappear. Version 1.2 has a T**ools** sheet with a macro button that resets the menu (see **Figure 41**). To activate the **Tools** sheet press **Ctrl**-**Shift**-**T** from within the Model file.

STANDARDIZED RECLAMATION COST ESTIMATOR
User Tools
Version 1.2.0 - Beta 4

These tools allow easy access to some useful VBA routines and macros that are include in this Model Version

Reset Menus — This option resets the **StdRecCost Menu** in case it gets removed from the tool bar

Keyboard Shortcuts	
SHORTCUT KEYS	ACTION
Ctrl-Shift-C	*Go to Table of Contents*
Ctrl-Shift-P	*Go to Property Information Sheet*
Ctrl-Shift-R	*Show Risk Matrix Table*
Ctrl-Shift-S	*Show Slope Conversion Table*
Ctrl-Shift-T	*Go to Tools sheet*

Figure 37 - User Tools (Version 1.2 or later)

If you are using an earlier version, go to the Macros option on the Tools menu (see **Figure 42**).

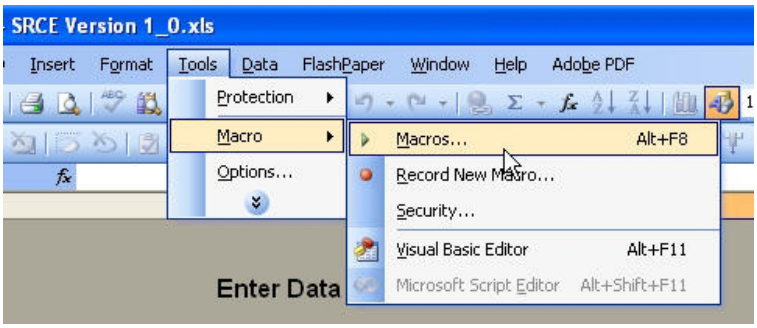


Figure 38 - Macro Menu

This will open another dialog box that will contain at least two macro names (see **Figure 43).** Select **MakeBondMenuBar** from the macro list and the **StdRecCost** menu option should reappear on the Excel menu.

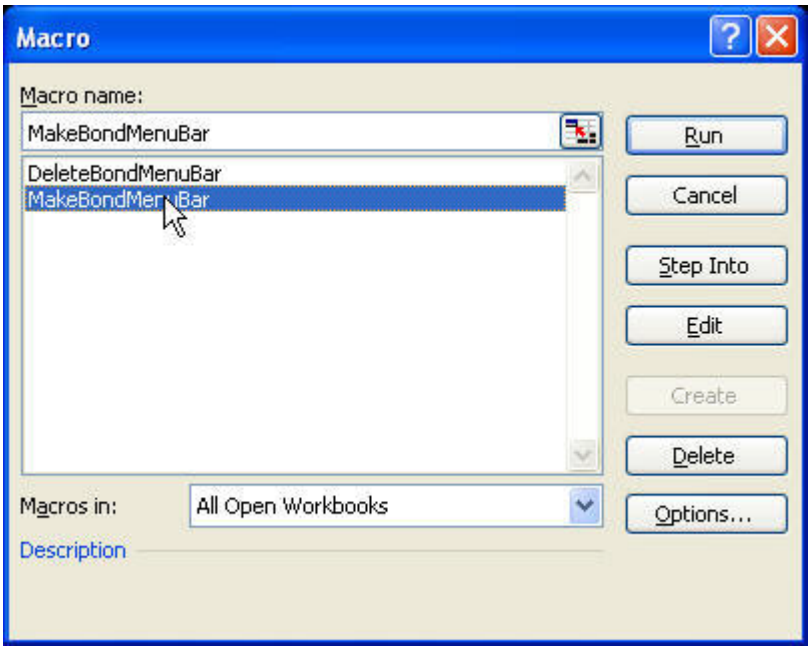


Figure 39 - Macro Dialog Box

… Get Additional Help

Additional help can be found on the NVBond.org web site (www.nvbond.org).

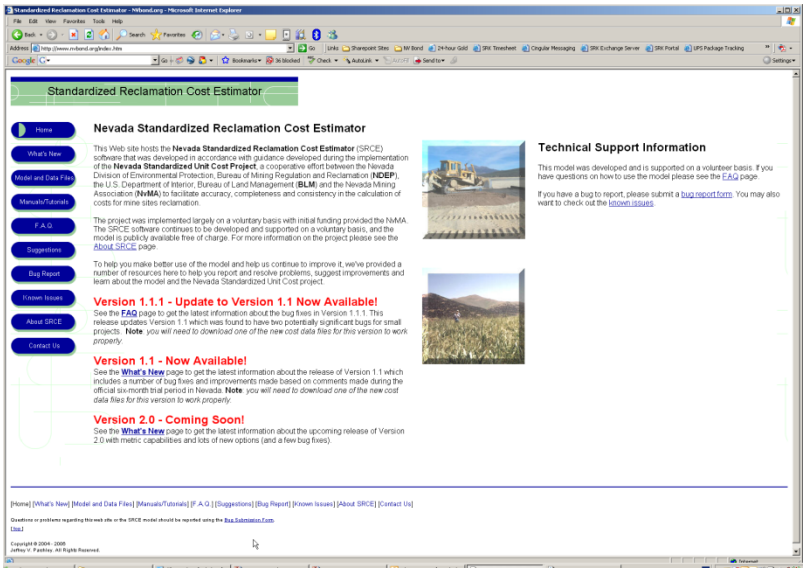

Standardized Reclamation Cost Estimator
Nevada Standardized Reclamation Cost Estimator
Technical Support Information
Version 1.1.1 - Update to Version 1.1 Now Available!
Version 1.1 - Now Available!
Version 2.0 - Coming Soon!

Figure 40 - NVBond.org Web Site

You can search for information under the FAQ page which contains answers to common questions asked during the beta testing along with some tips and tricks that were found to be useful.

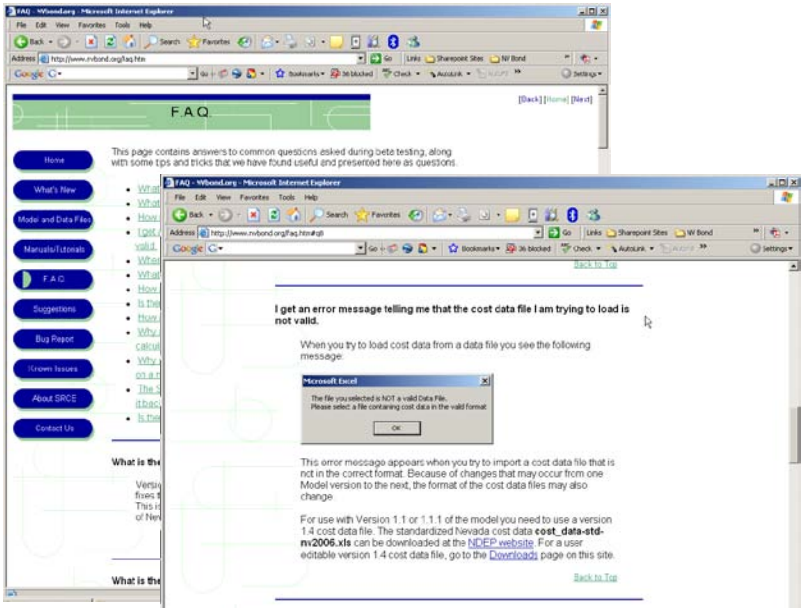


Figure 41 - Frequently Asked Questions (FAQ)

You can also look under Known Issues for anything that has been found to be an issue in the Model.

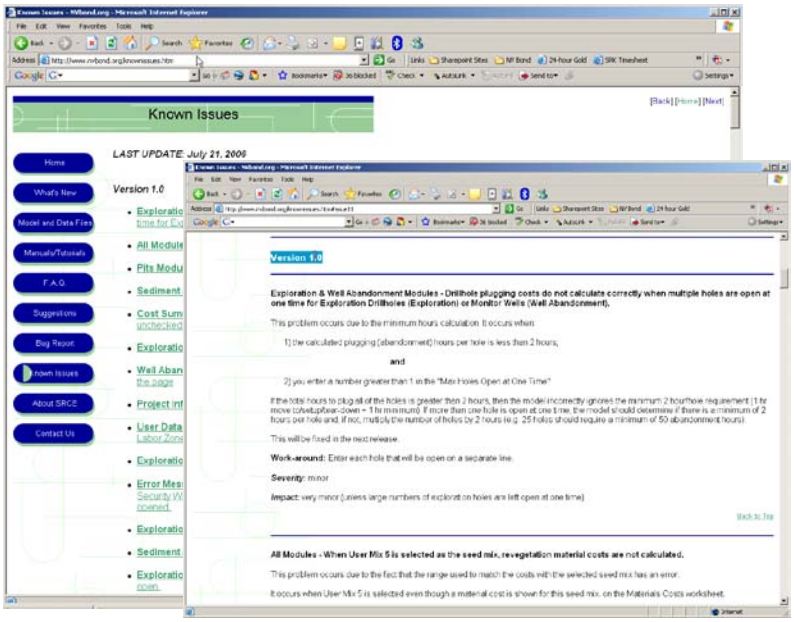

Known Issues
LAST UPDATE: July 21, 2006
Version 1.0
Version 1.0
Exploration & Well Abandonment Modules - Drillhole plugging costs do not calculate correctly when multiple holes are open at one time for Exploration Drillholes (Exploration) or Monitor Wells (Well Abandonment).
All Modules - When User Mix 5 is selected as the seed mix, revegetation material costs are not calculated.

Figure 42 - Known Issues Page

… Report a Model Bug

If you find a bug in the Model it can be reported on the NVBond.org web site (www.nvbond.org) by filling out and submitting a web-based Bug report.

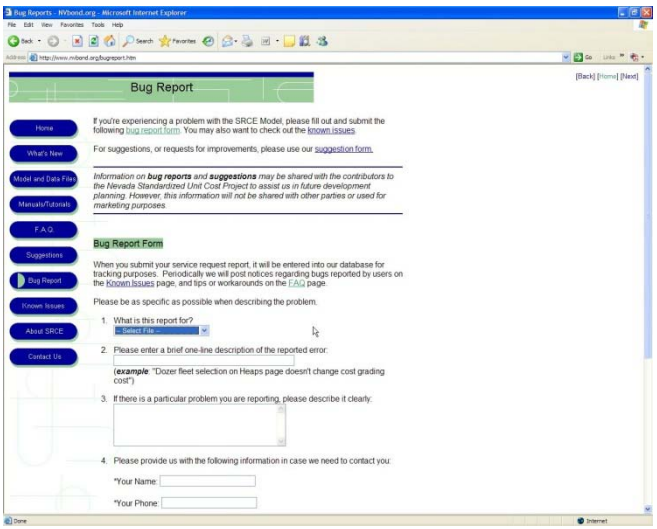


Figure 43 - NVBond.org Bug Report

… Make a Suggestion for Future Versions

If you have a suggestion for future versions of the Model these can be submitted online through the NVBond.org web site (www.nvbond.org)

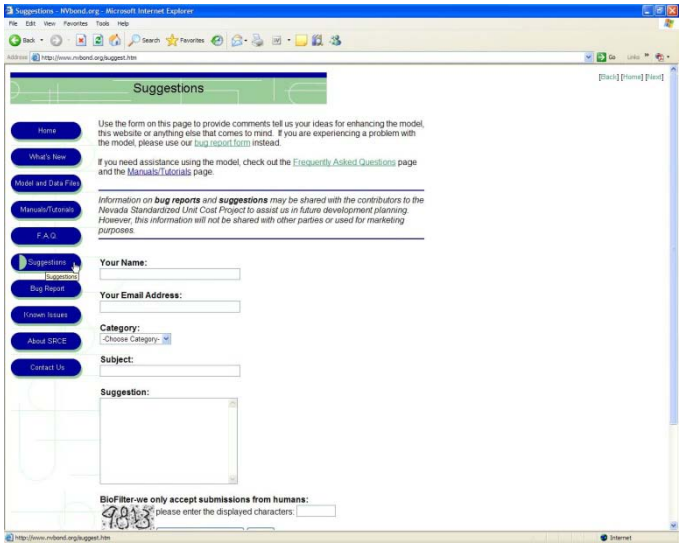

Suggestions
Home
What's New
Model and Data Files
Manuals/Tutorials
F.A.Q.
Suggestions
Bug Report
Known Issues
About SRCE
Contact Us
Use the form on this page to provide comments tell us your ideas for enhancing the model, this website or anything else that comes to mind. If you are experiencing a problem with the model, please use our bug report form instead.
If you need assistance using the model, check out the Frequently Asked Questions page and the Manuals/Tutorials page.
Information on bug reports and suggestions may be shared with the contributors to the Nevada Standardized Unit Cost Project to assist us in future development planning. However, this information will not be shared with other parties or used for marketing purposes.
Your Name:
Your Email Address:
Category:
-Choose Category-
Subject:
Suggestion:
BioFilter-we only accept submissions from humans:
please enter the displayed characters:

Figure 44 - NVBond.org Suggestion Page

Glossary

Administrative expense - the overhead cost due to the nonprofit-specific operations of a company. Generally includes top management salaries and the costs of legal, central purchasing, traffic, accounting, and other staff functions and their expenses for travel and accommodations. ‡

The Angle of Repose - The maximum slope or angle at which loose, cohesionless material remains stable.†

Asset Retirement Obligation (ARO) - An ARO estimate is the fair value of abandonment liabilities associated with mining and mineral processing operations for financial reporting purposes. In other words, it is the amount a mining company would pay a third party to assume responsibility for completing all closure activities (including a reasonable profit margin). ARO cost estimates are be prepared each year as part of the annual financial reporting requirements of some stock markets and adjusted to reflect any increases due to new development work or reductions resulting from completed closure work that occurred in the financial reporting year.

ARO (see Asset Retirement Obligation)

Aquifer - a geological formation, group of formations or part of a formation capable of yielding a significant amount of water to a well or spring.

Backfill - the material used to refill an excavation.

Basis - Documentation that describes how an estimate, schedule, or other plan component was developed and defines the information used in support of development. A basis document commonly includes, but is not limited to, a description of the scope included, methodologies used, references and defining deliverables used, assumptions and exclusions made, clarifications, adjustments, and some indication of the level of uncertainty. ‡

Berm a mound or wall of earth, rock or sand.

Best practices - measures, methods of operation or practices which are reasonably designed to prevent, eliminate or reduce water pollution from diffuse sources and which are consistent with the best practices in the particular field under the conditions applicable. This term is intended to be equivalent to the term "best management practices"*

Best Management Practices (BMP) - see Best Practices

Bund – see Berm

Chemically Stabilized - means the condition which results when contaminants in a material are bound or contained so as to prevent them from degrading the waters of

the State under the environmental conditions that may reasonably be expected to exist at a site.*

Closure Completion - the time when a closed mine progressed to a state where mining lease ownership can be surrendered/relinquished and responsibility accepted by the next land user (Department of Industry, Tourism and Resources, 2006). Mine completion aims to (ibid.):

Cyanide Code, The - The "International Cyanide Management Code for the Manufacture, Transport and Use of Cyanide in the Production of Gold" (Cyanide Code) is a voluntary industry program for the gold mining industry to promote, responsible management of cyanide used in gold mining, enhance the protection of human health, and reduce the potential for environmental impacts. (www.cyanidecode.org)

Deterministic cost estimating methodology – a cost estimating method in which the independent variable(s) are more or less a definitive measure of the item being estimated. A deterministic methodology is not subject to significant conjecture. (AACE International, 2003)

Facility - all portions of a mining operation, including, but not limited to, the mine, waste rock piles, or piles, beneficiation process components, processed ore disposal sites, and all associated buildings and structures.*

Field supervision - the cost of salaries and wages of all field supervisory and field support staff personnel (excluding general foreman), plus associated payroll burdens, home office overhead, living and travel allowances, and field office operating costs.‡

Fixed cost - those costs independent of short term variations in output of the system under consideration. Includes such costs as maintenance; plant overhead; and administrative, selling and research expense. For the purpose of cash flow calculation, depreciation is excluded (except in income tax calculations).‡

Fluid - any material or substance which flows or moves whether in a semisolid, liquid, sludge, gaseous or other form or state.*

Fluid management system - that portion of a facility which has been constructed to contain or transport process fluids.*

Footprint area - the area resulting from a horizontal projection of a facility.

Frustum of a Pyramid - The portion of a pyramid that lies between the base and a plane cutting through it parallel to the base.

Groundwater - all subsurface water comprising the zone of saturation, including perched zones of saturation, which could produce usable water.*

Growth medium - a material which is capable of supporting vegetation.*

Hazardous Material

Hazardous Waste – any waste material requiring special handing, transportation or disposal methods as proscribed by regulation or statue.

Home office cost - those necessary costs involved in the conduct of everyday business, which can be directly assigned to specific projects, processes, or end products, such as engineering, procurement, expediting, legal fees, auditor fees inspection, estimating, cost control, taxes, travel, reproduction, communications, etc.‡

Infiltration - the entry of water or fluid into the ground through such means as infiltration basis, septic systems or infiltration trenches.*

Injection well - a well used for the subsurface emplacement of fluids, except fluids associated with active drilling.*

Job overhead or Project management cost - the expense of such items as trailer, toilets, telephone, superintendent, transportation, temporary heat, testing, temporary office power, water, and similar items.‡

Labor cost - the salary plus all fringe benefits of construction workers and general labor on construction projects and labor crews in manufacturing or processing areas which can be definitely assigned to one product or process area or cost center.‡

DRAFT

Liner - a continuous layer of man-made or reconstructed natural materials, or a combination thereof which restricts the downward or lateral movement of liquids.*

Maintenance - the preservation of the functional integrity and efficiency of the equipment and structures of a mine closure project and includes, without limitation, any necessary preventive maintenance, corrective maintenance and replacement of equipment or structures.

Maintenance and repair cost - the total of labor, material, and other related costs incurred in conducting corrective and preventative maintenance and repair on a facility, on its systems and components, or on both. Maintenance does not usually include those items that cannot be expended within the year purchased. Such items must be considered as fixed capital.‡

Map Area (see Footprint area)

MCP (see Mine Closure Plan)

Meteoric waters - any form of precipitation falling from the earth's atmosphere.*

mg/L - means the concentration of a substance, in milligrams, present in one liter of the water.

Milestone - an important or critical event and/or activity that must occur when scheduled in the project cycle in order to achieve the project objective(s).‡

Mine Closure Plan (MCP) – a plan prepared in accordance with applicable regulations, corporate requirements or international standards that describes the objectives, actions and success criteria necessary to close a mine, or portion thereof.

Mining - means the process of extracting ores from the earth.*

Mitigation - means by which an environmental impact is avoided or minimized and may include:

1. Avoiding an environmental impact by not taking a certain action or parts of an action.

2. Minimizing an environmental impact by limiting the degree or magnitude of the action and its implementation.

3. Rectifying an environmental impact by repairing, rehabilitating or restoring the part of the environment affected.

4. Reducing or eliminating an environmental impact over time by preservation and maintenance during the life of the action.

5. Compensating for an environmental impact by replacing or providing substitute resources or environments.

Operating cost - the expenses incurred during the normal operation of a facility, or component, including labor, materials, utilities, and other related costs. Includes all fuel, lubricants, and normally scheduled part changes in order to keep a subsystem, system, particular item, or entire project functioning. Operating costs may also include general building maintenance, cleaning services, taxes, and similar items.‡

Performance bond - a bond that guarantees the work will be completed in accordance with the contract documents. The bond also assures the owner that the contractor will fulfill all contractual and financial obligations.‡

Permanent closure - the time in the operating life of a facility when activities for the final stabilization, removal or mitigation of sources are initiated.*

Permit - a written document issued pursuant to applicable commonwealth or provincial regulations, which describes the responsibilities and obligations of the holder

of the permit during the construction, operation, and temporary or permanent closure of a facility.

pH - the negative log of the hydrogen ion concentration.

Plan - a predetermined course of action over a specified period of time which represents a projected response to an anticipated environment in order to accomplish a specific set of adaptive objectives.‡

Planimeter - A planimeter is a device, which mechanically integrates an area and records that area on a drum and disk as a tracing point moves over the boundary of the figure to be measured. A planimeter consists of a graduated drum and disk, vernier, tracing point, anchor, and anchor point.

Plugging - the stoppage of the flow of water, oil or gas into or from a formation through a borehole or well penetrating that formation.*

Pond - a process component which stores, confines or otherwise significantly impedes the horizontal movement of process fluids. The term does not include tailings impoundments, vats, tanks or other non-earthen containers.*

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Process solution - any liquids, including meteoric waters, which are intentionally or unintentionally introduced into any portion of the beneficiation process components.*

Process solution stabilization - binding, containing or otherwise treating contaminants in a fluid, including, without limitation, meteoric waters, that have intentionally or unintentionally been introduced into a heap leaching facility or tailings facility to prevent the contaminants from degrading the surface water or groundwater through naturally occurring environmental conditions which may be reasonably expected at the mine site.*

Productive postmining land use - means a use which supports activities including: wildlife habitat; livestock grazing; agriculture and ranching; industry; recreation; or any other activities which benefit the Commonwealth, Providence, or the owner of the land.*

Productivity - In general terms, productivity can be defined as the ratio of the value that labor and equipment produces to the value invested in labor and equipment. It is an absolute measure of work process efficiency, i.e., a measure of the extent to which resources are minimized and wasted effort is eliminated from the work process.‡

Profit‡

(1) Gross Profit - earnings from an on-going business after direct costs of goods sold have been deducted from sales revenue for a given period.

(2) Net Profit - earnings or income after subtracting miscellaneous income and expenses (patent royalties, interest, capital gains) and federal income tax from operating profit.

(3) Operating Profit - earnings or income after all expenses (selling, administrative, depreciation) have been deducted from gross profit.

Project management cost (see Job overhead)

Reclamation - actions performed during or after an exploration project or mining operation to shape, stabilize, revegetate or otherwise treat the land in order to return it to a safe, stable condition consistent with the establishment of a productive post mining use of the land and the safe abandonment of a facility in a manner which ensures the public safety, as well as the encouragement of techniques which minimize the adverse visual effects.*

Quality assurance - all those planned or systematic actions necessary to provide adequate confidence that a product, process, or service will conform to established requirements.‡

Quality control - inspection, test, evaluation or other necessary action to verify that a product, process, or service conforms to established requirements and specifications.‡

Quality management - concerns the optimization of the quality activities involved in producing a quality product, process or service. As such, it includes appraisal, training, and prevention activities.‡

Regrade (regrading) – reshaping of a surface to create a different surface profile - reprofile, reshape.

Resale value - the monetary sum expected from the disposal of an asset at the end of its economic life, its useful life, or at the end of the study period.‡

Revegetation – the actions taken to establish vegetation at a mine site, or portion thereof that will be consistent with the post-mining land use and self sustaining.

Salvage value - (1) the cost recovered or which could be recovered from a used property when removed, sold, or scrapped; (2) the market value of a machine or facility at any point in time (normally an estimate of an asset's net market value at the end of its estimated life); (3) the value of an asset, assigned for tax computation purposes, that is expected to remain at the end of the depreciation period.‡

Schedule - the plan for completion of a project based on a logical arrangement of activities, resources available, imposed dates or funding budgets.‡

Specification, design (prescriptive) - a design specification providing a detailed written and/or graphic presentation of the required properties of a product, material, or piece of equipment, and prescribing the procedure for its fabrication, erection, and installation.‡

Specification, performance - a statement of required results, verifiable as meeting stipulated criteria, and generally free of instruction as to the method of accomplishment.‡

Specifications - written directions regarding the quality of materials and the nature of the workmanship for a job. Specifications may be written directly on the drawings, or presented in a separate document.‡

Spring - a naturally occurring point of discharge where groundwater becomes surface water, regardless of whether the water is developed for use.*

Stochastic cost estimating method – a cost estimating method in which the independent variable(s) used in the cost estimating algorithms are generally something other than a direct measure of the units of the item being estimated. The cost estimating relationships used in stochastic methods often are somewhat subject to conjecture. (AACE International, 2003)

SU - standard pH units.

Supplier - a manufacturer, fabricator, distributor or vendor.‡

Surety - 1) a bond that provides sufficient funds to ensure a responsible government agency that the approved reclamation and closure activities for a project can be performed by a third-party should the operator default on their obligation; 2) a bonding company licensed to conduct business which guarantees the owner that the contract will be completed (Performance Bond) and that subcontractors and suppliers will be paid (Payment Bond).

Surface area - the area of the (non-planar) surface of a facility to accurately estimate cover and revegetation areas.

Surface water - all water open to the atmosphere and subject to surface runoff.*

System - a collection of hardware (equipment and facilities) and related software (procedures, etc) designated to perform a unique and useful function. A system contains everything necessary (except personnel and materials or supplies) to perform its defined function.‡

Tailings impoundment - a process component which is the final depository for processed ore discharged from a mill.*

DRAFT

Task - Smallest unit of work planned. It must have an identifiable start and finish, and usually produces some recognizable results.‡

Temporary closure - the cessation of the operation of a process component for more than 30 days as a result of a planned or unplanned activity.*

Topsoil - the material at or near the surface of the earth which has been modified and acted upon by natural, physical, chemical or biological agents in a manner which will allow it to support revegetation.*

Uncertainty - unknown future events which cannot be predicted quantitatively within useful limits, eg, accidents which destroy invested facilities, a major strike, a competitor's innovation which makes the new product obsolete.‡

Unit cost - cost per unit of production. It is usually total cost divided by units of production, but a major cost divided by units of production is frequently referred to as a unit cost; for example, the total unit cost is frequently subdivided into the unit costs for labor, chemicals, etc.‡

Updating - the regular review, analysis, evaluation, and reporting of progress of the project, including recomputation of an estimate or schedule.‡

Useful life - the period of time over which an investment is considered to meet its original objective.‡

Wastewater - a combination of the liquid- and water- carried wastes from a residence, commercial building, industrial plant or institution and any groundwater, surface water or storm water that is present.*

Water well - an encased excavation made by any drilling method for the development of groundwater from its source.*

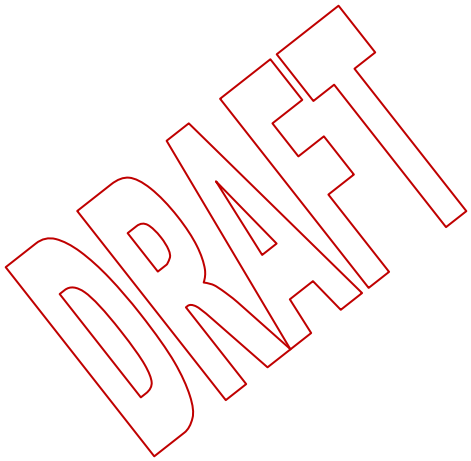
Zero discharge - the standard of performance for the protection of surface waters which requires the containment of all process solutions.*

Definition sources:

*Nevada Administrative Code (NAC) - NAC445A or NAC519A.

†Dictionary of Geological Terms, 3rd Edition, American Geological Institute.

‡AACE International Recommended Practice No. 10S-90 - Cost Engineering Terminology, Copyright © 2004, Association for the Advancement of Cost Estimation.



Index

Add, 5-3, 6-6
backfilling, 2-1, 5-6, 5-8, 5-14, 5-15, 5-16, 5-19, 6-6
BLM, 1-1, 4-6
buildings, 5-16, 5-17, 5-18, 2
Buildings, 5-16, 5-17
CAD, 1-2, 3-4
CAT® Handbook, 2-4, 2-5, 2-8, 1
Clear Sheet, **5-3**
Construction Management, 5-25, 5-26
correction factors, 2-5, 2-6
Cost Data, 2-4, 2-6, 2-4, 3-1, 3-2, 3-3, 4-1, *4-3*, **5-4**, 5-15, 6-1, *6-7*
cover, 2-3, 5-7, 5-9, 5-12, 5-13, 5-15, 5-16, 5-17, 5-19, 6-4, 6-5, 6-6, 7
cut and fill areas, 2-2, 2-3
cut-to-fill, 2-2, 2-3, 5-6
Cyanide Code, 6-6, 2
Data File, 3-2, 3-3, 4-1, 4-2, *4-3*, **5-5**
Density, 2-5
drill pads, 5-5, 5-7
drillhole, 2-4, **5-5**, 5-6
Equipment Costs, 4-3
exploration drill roads, 5-6, 5-8
Fertilizers, *6-6*
fleets, 2-8, 3-2, **5-5**, 5-15, 5-16
footprint, 2-3, 3-4, 5-9, 5-11, 5-17, 6-4
Foundations, 5-16, 5-17
furstrum, 2-1
GIS, 1-2, 3-4
Growth medium, 3
Haul Material, 5-14, 5-15, 5-16, 6-4, 6-5, 6-6
Heap, 2-3, 5-2, 5-9, 5-10, 6-4
heap leach, 2-3, 5-10, 5-12, 5-13, 6-3
Job Efficiency, 2-5, 1, 2
lift, 2-7, 5-11, 5-12, 6-3, 6-4
Manning's Equation, 2-8
Means Heavy Construction, 2-4, 2-6, 2-4, 3-2, 4-5, 5-17, 5-22, 5-15
Means Heavy Construction Cost Estimating Guide, 3-2, 4-5
mid-bench length, 2-3, 5-9, 6-3, 6-4
Misc. Costs, 5-21, 5-22, 5-32, 6-6
Monitor wells, 5-21
Monitoring, 4-5, 5-22, 5-23, 5-24, 5-25, *6-6*
Mulch, *6-6*
NDEP, 1-1
NVBond.org, 6-1, *6-9*, *6-11*
Operator Efficiency, 2-5, 1, 2
override, 5-2, 5-6, 5-14, 5-16, 5-18, 5-19
production wells, 5-22
Productivity, 1-3, 2-4, 2-5, 2-6, 5, 1
regions, 4-1, 4-2, 4-3, *4-4*, 4-5
Rental Rate, *4-3*
Revegetation, *4-5*, 5-14, 5-23, 6-5, 6-6, 6
Road Maintenance, 5-25, 5-26
SRCE, 1-1, 1-2
surface area, 2-3, 5-7, 5-9, 5-13, 5-23, 6-5
tailings, 2-3, 5-12, 5-13, 5
trenches, 5-5, 5-6, 3
User Sheets, 4-5, 5-32, 6-6
waste rock dump, 5-10, 5-11, 5-12, 5-13, 6-3, 6-4
wells, 2-6, 5-21, 5-22

References

Appendix A - Technical Reference

Truck/Loader Fleet Productivity Calculations

(Version 1.3)

Truck and Loader Capacities *= from CAT® Handbook (see Productivity worksheet)*

Average Capacity of Loader *= Struck Bucket Capacity + ½ (Heaped Bucket Capacity – Struck Bucket Capacity)*

Loader Cycle Time *= from CAT® Handbook (see Productivity worksheet)*

Haul Operator Efficiency *= 0.75 (Average)*

Job Efficiency *= 0.83 (50min/hr)*

Number of Passes to Fill Truck *= Heaped Capacity of Truck ÷ Average Capacity of Loader [heaped truck capacity used because that his how trucks are loaded by a FEL (i.e. they keep loading until material spills out of bed of truck)]*

Truck Loading Time *= Loader Cycle Time x Number of Passes to Fill Truck*

Loaded Travel Time *= from curves [uphill] or grade retarder (speed) tables [downhill]*

Empty Travel Time *= from curves [uphill] or grade retarder (speed) tables [downhill]*

Total Truck Travel Time *= Loaded Travel Time + Empty Travel Time*

Truck Cycle Time *= Maneuver to Load Time +Truck Loading Time + Maneuver to Dump Time + Total Truck Travel Time*

Number of Trucks Required *= Truck Cycle Time – Truck Loading Time) ÷ Truck Loading Time [rounded up to nearest integer]*

Truck Productivity *= 60 min/hr ÷ Total Cycle Time x Avg. Truck Capacity*

Fleet Productivity *= Number of Trucks Required x Truck Productivity x Haul Operator Efficiency x Job Efficiency*

Work Hours *= Total Volume to be Hauled ÷Fleet Productivity*

Conservative assumptions:

Average Loader Capacity is used for Number of Passes to Fill Truck

Average Truck Capacity is used to calculate Truck Productivity even though cycle time is calculated based on Heaped Capacity of Truck

Average Haul Operator Efficiency factor (1.0) is applied to trucks in Nevada SRCE, can be adjusted in International SRCE.

Job Efficiency of 50min/hr in Nevada SRCE, can be adjusted in International SRCE.

Appendix B – Tutorial Exercises

Exercise 1: Simple Waste Rock Dump

This exercise uses an example of a single lift waste rock dump with a consistent height.

The first step is to determine what the closure plan for the dump is. What does it say about the following:

- Regrading
- Cover
- Topsoil
- Ripping
- Seeding

The next step is to determine the key geometric parameters that the Model needs to perform the volumetric and area calculations. Use the map for Exercise 1 to fill in the blanks below.

- Dump height = 20 m
- Mid-bench length = _____ m
- Underlying (toe) slope _____ % grade
- Current dump slope ___H:1V
- Final dump slope 2.7H:1V
- Final footprint area _____ ha
- Final slope on top of dump 1 % grade

Other things that need to be considered:

- Cover borrow sources
- Topsoil borrow sources
- Revegetation types

Exercise 1: Answers

Here's how our measurements came out:

- Dump height = 20 m
- Mid-bench length = _1147_ m
- Underlying (toe) slope = _1_ % grade
- Current dump slope = _2_ H:1V
- Final dump slope 2.7H:1V
- Final footprint area = _11_ ha
- Final slope on top of dump 1 % grade

Exercise 2: Complex Waste Rock Dump

This exercise uses an example of a multiple lift waste rock dump with varying heights and current slopes.

The first step is to determine what the closure plan for the dump is. What does it say about the following:

- Regrading
- Cover
- Topsoil
- Ripping
- Seeding

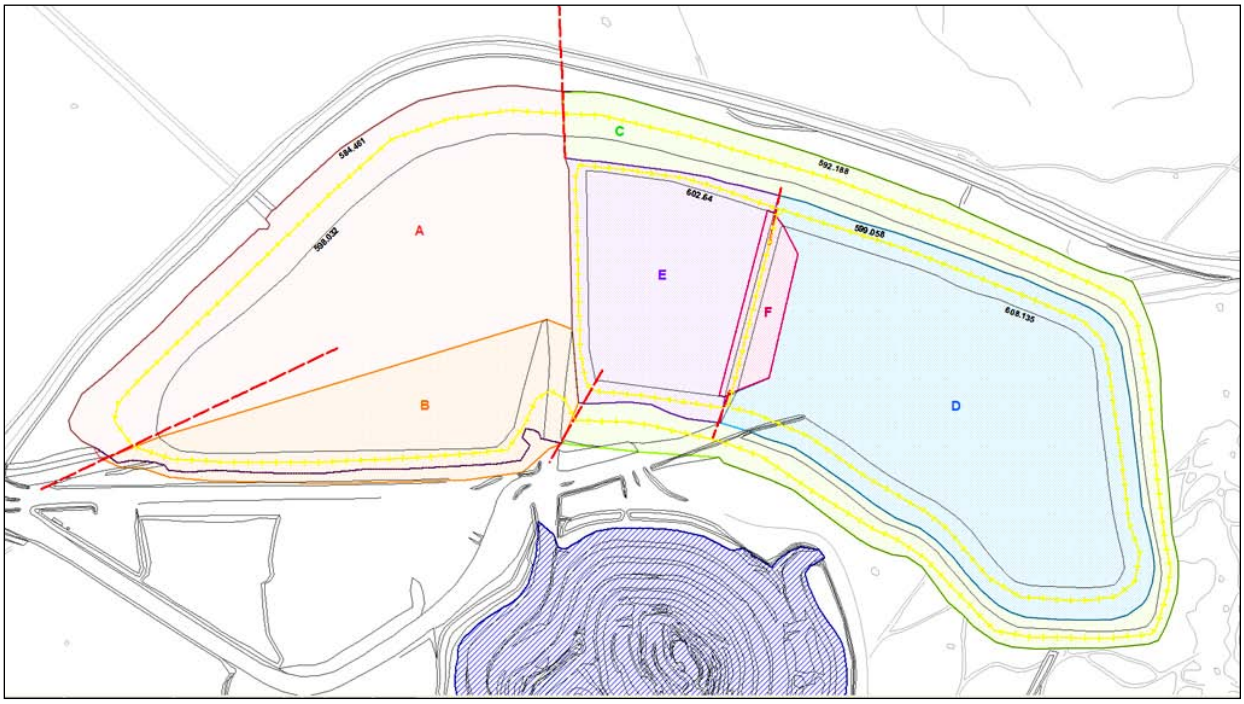
The next step is to determine the key geometric parameters that the Model needs to perform the volumetric and area calculations. Use the map for Exercise 2 to fill in the blanks below.

- Dump heights = _____ , _____, _____, _____, _____ ,_____ m
- Mid-bench length = _____, _____, _____, _____, _____, _____ m
- Underlying (toe) slope = <1 %
- Current dump slope = _____, _____, _____, _____, _____, _____ H:1V
- Final dump slope = 2.7H:1V minimum
- Final footprint area = _____, _____, _____, _____, _____, _____ ha
- Final slope on top of dump 1 % grade

Hint: there are six sets of blanks because we divided this dump into six areas for entry into the Model.

Exercise 2: Answers

Here's how we divided the waste rock dump into areas A through F:



- Dump heights = 14 , 14 , 7 , 9 , 3 , 6 m
- Mid-bench length = 691 , 554 , 1746 , 1176 , 631 , 230 m
- Underlying (toe) slope = <1 %
- Current dump slope = 3.7 , 1.6 , 3.7 , 3.7 , 6 , 2.1 H:1V
- Final dump slope = 2.7H:1V minimum
- Final footprint area = 12 , 5 , 8 , 14 , 5 , 1 ha
- Final slope on top of dump 1 % grade

Exercise 3: Tailings Impoundment

This exercise uses an example of a two cell tailings impoundment with different embankments heights.

The first step is to determine what the closure plan for the tailings impoundment is. What does it say about the following:

- Regrading
- Cover
- Topsoil
- Ripping
- Seeding

The next step is to determine the key geometric parameters that the Model needs to perform the volumetric and area calculations. Use the map for Exercise 3 to fill in the blanks below.

- Embankment height = 20, 8 m
- Mid-embankment length = _____, _____ m
- Underlying (toe) slope = ___, ___ %
- Current embankment slope = ___, ___H:1V
- Final embankment slope = ___, ___ H:1V
- Tailings surface area = ____, ____ ha
- Tailings regrade volume = _____ m3

Hint: there are two sets of blanks because we handled the two impoundment cells separately for entry into the Model.

Exercise 3: Answers

Here are our measurements for the two cells:

- Embankment height = 20, 8 m
- Mid-embankment length = 2306 , 867 m
- Underlying (toe) slope = <1 , <1 %
- Current embankment slope = 2.7 , 2.7 H:1V
- Final embankment slope = 2.7 , 2.7 H:1V
- Tailings surface area = 40.4 , 9.6 ha
- Tailings regrade volume = ? , ? m3 (for the regrade volume you will need a regrading plan to determine how much material must be moved to create the final top surface)

Exercise 4: Open Pits

This exercise uses an example of a single pit with a partial safety berm (bund) in place.

The first step is to determine what the closure plan indicates how far from the final pit highwall to construct the berm (bund). In the example shown in this figure the pit buffer line represents the maximum possible area that could collapse into the pit. The pit safety berm (bund) should be placed outside this area.

Use the figure for Exercise 2 to fill in the blanks:

- How much of the existing safety berm (bund) needs to be replaced because it is inside the pit buffer? _____ m

- How much new safety berm (bund) need to be constructed? _____ m

Hint: You shouldn't need a safety berm (bund) if there is a facility adjacent to the pit that would keep people from the pit (e.g. a waste rock dump).

Exercise 4: Answers

Here are our answers for Exercise 4:

- How much of the existing safety berm (bund) needs to be replaced because it is inside the pit buffer? 550 m

- How much new safety berm (bund) need to be constructed? 970 m

Exercise 5: Roads

This exercise uses a site map (in back pocket) to determine the length and width of several roads.

Use the large Training Exercise Area figure to fill in the blanks:

- How long is the road from the main access road (intersection southeast of the ROM pad) to the intersection at the southwest corner of the Area 4 WRD? _____ m
- What is the average width of this road? _____ m
- What is the slope of the natural ground over which this road traverses? _____% grade
- How long is the road from the main access road to the mine camp? _____ m
- What is the average width of this road? _____ m
- What is the slope of the natural ground over which this road traverses? _____% grade

Exercise 5: Answers

Here are our answers for Exercise 5:

- How long is the road from the main access road (intersection southeast of the ROM pad) to the intersection at the southwest corner of the Area 4 WRD? : _2020_ m
- What is the average width of this road? : _10_ m
- What is the slope of the natural ground over which this road traverses? : _1_ % grade
- How long is the road from the main access road to the mine camp? : _675_ m
- What is the average width of this road? : _10_ m
- What is the slope of the natural ground over which this road traverses? : _1_ % grade

Exercise 6: Ponds

This exercise uses a site map (in back pocket) to determine dimensions of ponds.

Use the large Training Exercise Area figure to fill in the blanks:

- What are the dimensions of Pond #1? width:_____m, length:_____m, depth: _5_m
- Pond #1 sideslope angle = 2H:1V
- What are the dimensions of Pond #2? width:_____m, length:_____m, depth: _5_m
- Pond #2 sideslope angle = 2H:1V
- What are the dimensions of Pond #10? width:_____m, length:_____m, depth: _5_m
- Pond #10 sideslope angle = 2H:1V

Exercise 6: Answers

Here are our answers for Exercise 6:

- What are the dimensions of Pond #1? width: 55 m, length: 55 m, depth: 5 m
- Pond #1 sideslope angle = 2H:1V
- What are the dimensions of Pond #2? width: 55 m, length: 55 m, depth: 5 m
- Pond #2 sideslope angle = 2H:1V
- What are the dimensions of Pond #10? width: 68 m, length: 70 m, depth: 5 m
- Pond #10 sideslope angle = 2H:1V

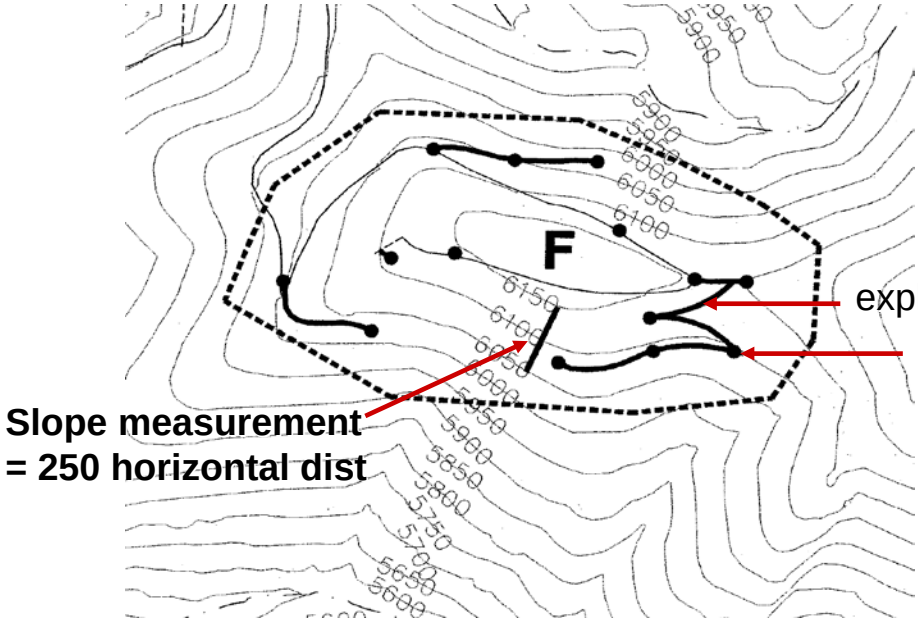
Exercise 7: Exploration Roads

This exercise uses an example of a two cell tailings impoundment with different embankments heights.

Use the figure for Exercise 7 to fill in the blanks:

- No. of Drill Sites = _____
- Avg. Pad Width = 15 m
- Avg. Length = 20 m
- Avg. Sump Dimensions: 7L x 3W x 2D
- Length of Road = 610 m
- Width of Road = 5 m
- Slope = _____ % grade
- Cut Slope Angle = 70 deg
- Fill Slope Angle = 1.3H:1V

Exercise 7– Exploration Drill Roads and Pads



Contour interval = 50

Additional Information:
Working versions of the Standardized Reclamation Cost Estimator (the Model) and additional user support information including this manual is available at www.nvbond.org.

Exercise 7: Answers

Here are our answers for Exercise 7:

- No. of Drill Sites = 14 total
- Avg. Pad Width = 15 m
- Avg. Length = 20 m
- Avg. Sump Dimensions: 7L x 3W x 2D
- Length of Road = 610 m
- Width of Road = 5 m
- Slope = 40 % grade
- Cut Slope Angle = 70 deg
- Fill Slope Angle = 1.3H:1V